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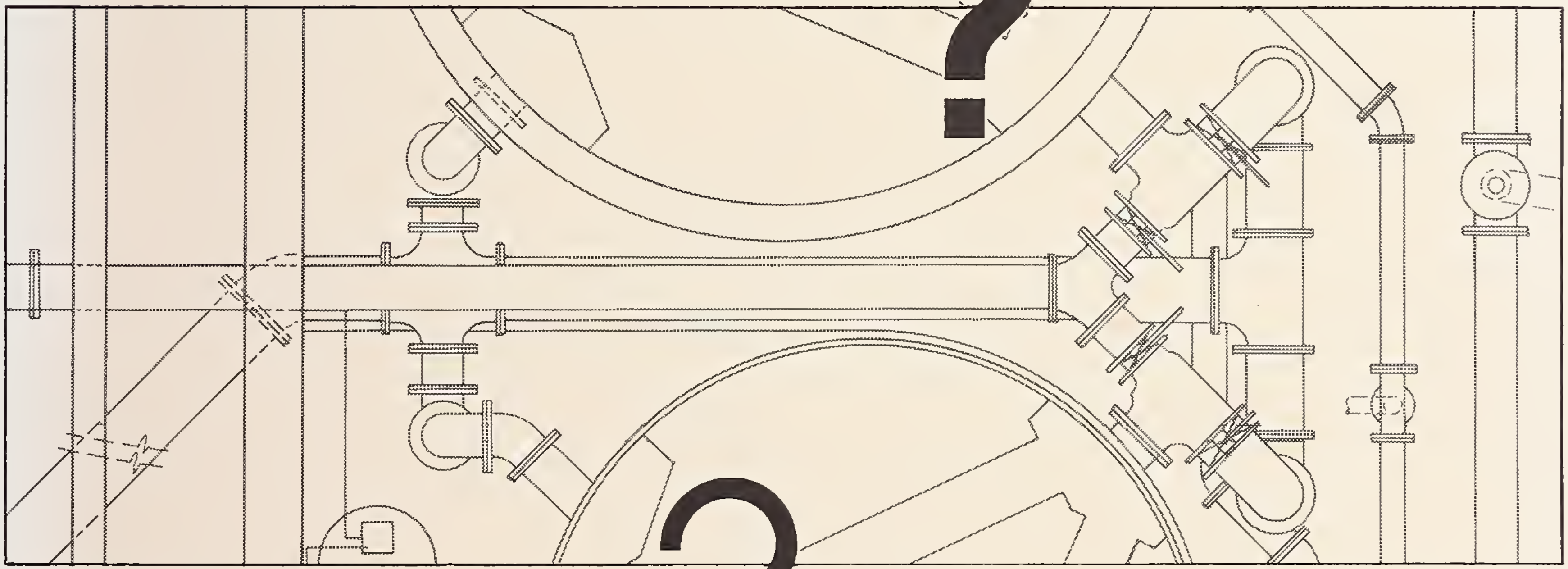

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1gpm = ? cfs

$$hL=\frac{KV^2}{2g}$$

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If you have any ideas or information that you would like to pass along to other people involved in the water and wastewater field, please don't hesitate to contact the office of the Water Quality Bureau. This publication welcomes articles of interest and random pieces of information regarding anything to do with water.

An article may consist of your own thoughts and ideas about something you may have experienced. Perhaps such information could help someone else in their day-to-day work. It could also be a technical article that is developed from research information and library resource material. If it has to do with water and you think it may be of interest, give us a call at the WQB: 444-2406.

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A Little Bit About Measurement

ml. * kg. * cm. * lbs. * ft.

by Dave Aune, Water Quality Bureau

From the earliest of times, man has found a need to take and record measurements. Early civilizations needed to know when to plant crops and therefore needed to measure time. Village traders needed to know how to exchange goods and therefore needed to measure weight and volume. Early carpenters needed to measure length and area to build ships and homes.

All units of measure have a standard from which the unit can be duplicated for future use. The standards for early units of measure are quite interesting and were often based on human features or common objects. For example, in the fifteenth century the yard was introduced as the distance from a persons nose to the tip of the middle finger, a standard that clearly favored a long armed individual when it came to purchasing goods. In other examples, the inch was defined as the length of three round and dry barleycorns laid together, and the unit grain was based on the weight of a grain of wheat taken as an average of the weight of grains from the middle of a head of wheat. Certainly, the ability to accurately duplicate these types of measurements from one situation and/or location to the next was limited.

Another problem with early measurement systems was the lack of standardization and uniformity from one location to the next. This did not present much of a problem within a single village where everyone in the village understood the custom. However, as commercial activities expanded from province to province and country to country the need for a standardized system of measurement became apparent. The incentive to develop standardized systems of measurement was universal and many different parts of the world began developing systems simultaneously. This simultaneous development of measurement systems resulted in different parts of the world adopting different measurement systems.

Today there are three basic systems of measurement. They are the English System, the Metric System, and the International System of Units (SI). With few exceptions, the metric and SI systems use the same units of measure (meter, gram etc.), but have different standards for each unit of measure (physical objects vs physical constants). For most practical applications, such as water and wastewater system operation, it is not important to distinguish between the Metric and SI systems. We need only to concentrate on the English and Metric systems.

THE ENGLISH SYSTEM

The English system is the common system of measurement in many english speaking countries and the system many of us are most familiar with. This system consists of such measurement units as the pound (lb), foot (ft), and gallon (gal), to name just a few. The english system is generally defined with sufficient precision for commerce and manufacturing, but is not considered useful for scientific purposes. One of the main reasons the english system is not as useful as other systems is because there is no regularity between units. Length may be expressed in inches, feet, yards and miles, but the number of inches in a foot is 12, the number of feet in a yard is 3, and the number of yards in a mile is 1760. This lack of regularity makes calculations more difficult and makes it more difficult to remember various unit conversions.

THE METRIC SYSTEM

The Metric system was developed in France in the late 1700's to standardize measurement among the various provinces of France. The metric system is more popular with most nations of the world and accordingly, the United States has become an isle in a metric world. While the english system continues to be widely used in the Unites States, there is a slow, but steady movement towards the metric system of measurement.

The Metric system is a decimal system, that is, it is a system of tens. The several units by which a measured property may be expressed differ from one another by factors of ten. For example a meter equals 100 centimeters, a milligram equals .001 grams, a kilogram equals 1000 grams, and a liter equals 1000 cubic centimeters. The Table below illustrates the meaning of some of the common prefixes used with the metric system.

COMMONLY USED METRIC SYSTEM PREFIXES

mega (M)	10^6	means one million times the base unit
kilo (k)	10^3	means one thousand times the base unit
centi (c)	10^{-2}	means one hundredth of the base unit
milli (m)	10^{-3}	means one thousandth of the base unit
micro (u)	10^{-6}	means one millionth of the base unit
nano (n)	10^{-9}	means one billionth of the base unit

BASIC UNITS

While measurement systems have become more standardized and the basis for the various units of measurement have increased in sophistication and accuracy, the basic units and combination of units has not changed. The basic physical properties that must be measured to describe the physical world are length, time, temperature, and mass (or weight). These are the basic units of measure. Other physical properties such as area, volume, velocity, density and concentration can be described by a combination of these basic units of measure, that is, they can be derived. Table 1. lists a few basic and derived units of measure for both the english and metric systems.

While it is hoped that this article provides the reader with some insight into the various measurement systems, it is far more important for the water and waste water operator to be able to apply measurements such that system operation is improved. For this reason, we have included a few example calculations illustrating the use of measurements for calculating such physical properties as area and volume. Future Clearwater editions will expand on this by providing sample calculations describing other physical properties.

TABLE 1. MEASUREMENT UNITS

BASIC PHYSICAL PROPERTIES AND UNITS OF MEASURE

PHYSICAL PROPERTY	BASE ENGLISH UNIT	OTHER ENGLISH UNITS	BASE METRIC UNIT	MULTIPLES OF THE BASE METRIC UNIT
LENGTH	yard(yd)	mile(mi) feet(ft) inch(in)	meter(m)	kilometer(km) centimeter(cm) millimeter(mm)
WEIGHT	pound(lb)	ton(T) ounce	gram(g)	kilogram(kg) milligram(mg)
TIME	second(s)	minute(m) hour(h) day(d)	second(s)	minute(m) hour(h) day(d)

DERIVED PHYSICAL PROPERTIES AND UNITS OF MEASURE

PHYSICAL PROPERTY & DESC.	BASE ENGLISH UNIT	OTHER ENGLISH UNITS	BASE METRIC UNIT	MULTIPLES OF THE BASE METRIC UNIT
AREA- square length	square yard(yd^2)	ft^2 mi^2 acre	square meter(m^2)	cm^2 km^2 hectare
VOLUME- cubic length	cubic yard(yd^3)	ft^3 in^3 gallon quart	cubic meter(m^3)	cm^3 mm^3 liter(L) milliliter(ml)
VELOCITY- length per unit time	feet per second (ft/s)	mi/h ft/m	meter per second (m/s)	km/s
FLOW RATE- volume per unit time	cubic foot per second (ft^3/s)	gal/m(gpm) gal/d	cubic meter per second (m/s)	L/m

TABLE 2 BASIC CONVERSION FACTORS

UNITS		
1,000,000	= 1 Million	1,000,000/1 Million
LENGTH		
12 in	= 1 ft	12 in/ft
3 ft	= 1 yd	3 ft/yd
5280 ft	= 1 mi	5280 ft/mi
AREA		
144 sq in	= 1 sq ft	144 sq in/sq ft
43,560 sq ft	= 1 acre	43,560 sq ft/ac
VOLUME		
7.48 gal	= 1 cu ft	7.48 gal/cu ft
1000 m*L*	= 1 liter	1000 m*L*/*L*
3.785 *L*	= 1 gal	3.785 *L*/gal
231 cu in	= 1 gal	231 cu in/gal
WEIGHT		
1000 mg	= 1 gm	1000 mg/gm
1000 gm	= 1 kg	1000 gm/kg
454 gm	= 1 lb	454 gm/lb
2.2 lbs	= 1 kg	2.2 lbs/kg

DOSAGE		
17.1 mg/*L*	= 1 grain/gal	17.1 mg/*L*/gpg
64.8 grains	= 1 mg	64.8 grains/mg
PRESSURE		
2.31 ft water	= 1 psi	2.31 ft water/psi
0.433 psi	= 1 ft water	0.433 psi/ft water
1.133 ft water	= 1 in Mercury	1.133 ft water/in Mercury
FLOW		
694 GPM	= 1 MGD	694 GPM/MGD
1.55 CFS	= 1 MGD	1.55 CFS/MGD
TIME		
60 sec	= 1 min	60 sec/min
60 min	= 1 hr	60 min/hr
24 hr	= 1 day	24 hr/day

SCIENTIFIC NOTATION

Based on powers of 10 : $10^1 = 10$

$10^2 = 10 \times 10 = 100$

$$\boxed{10^3 = 10 \times 10 \times 10 = 1000}$$

$10^4 =$ - - - - - - - $= 10,000$

$10^5 =$ - - - - - - - $= 100,000$

$$\boxed{10^6 = \text{- - - - - - -} = 1,000,000}$$

$10^0 = 1$

$$10^{-1} = \frac{1}{10} = .1$$

$$10^{-2} = \frac{1}{10 \times 10} = \frac{1}{100} = .01$$

$$\boxed{10^{-3} = .001 \text{ (thousandth)}}$$

$10^{-4} = .0001$

$10^{-5} = .00001$

$$\boxed{10^{-6} = .000001 \text{ (millionth)}}$$

Special names for some powers of ten:

10^6	mega	(M)
10^3	kilo	(k)
10^{-1}	deci	(d)
10^{-2}	centi	(c)
10^{-3}	milli	(m)
10^{-6}	micro	(μ) or (u)
10^{-9}	nano	(n)
10^{-12}	pico	(p)

Use of Scientific Notation

Rule 1. - To convert from decimal to scientific notation:

a) Put in the decimal point.

b) Count number of spaces the decimal must be moved till we have a number between 1 and 9.99 (to the left is positive, to the right is negative).

c) Rewrite as : Number between 1 and 9.99, times 10 raised to the power determined in (b)

	567,000	.0173
a)	567,000.	.0173
b)	5.67,000. <-------- (+5)	.01.73 ---> (-2)
c)	5.67×10^5	1.73×10^{-2}

Rule 2. - To convert from scientific notation to decimal :

	3.4×10^4	2.778×10^{-3}
a) Write down the decimal part of the number	a) 3.4	2.778
b) As indicated by the power of 10, move the decimal point the correct number of spaces, adding zeros if necessary. (The sign of power will tell you whether the resulting number is to be larger or smaller than the value written in (a)).	b) 3.4000. ----> (+4)	.002.778 <--- (-3)
c) Rewrite with new location of the decimal.	c) 34,000	.002778

Rule 3. - To add or subtract:

a) Convert all numbers to the same power of 10

b) Add or subtract the decimal portions of the numbers but do not change the power of 10.

c) Adjust location of decimal point, if necessary.

Examples:

$$\begin{array}{r} 1.2 \times 10^3 \\ + \; 3.38 \times 10^3 \\ \hline 4.58 \times 10^3 \end{array} \qquad \begin{array}{r} 6.68 \times 10^{-4} \\ - \; 6.59 \times 10^{-4} \\ \hline 0.09 \times 10^{-4} \end{array} \text{ or } 9 \times 10^{-6}$$

$$1.8 \times 10^3 + 3.13 \times 10^4 + 9 \times 10^2 = \begin{array}{r} 1.8 \times 10^3 \\ 3.13 \times 10^4 \\ 9 \times 10^2 \\ \hline \end{array} \longrightarrow \begin{array}{r} 18 \times 10^2 \\ 313 \times 10^2 \\ 9 \times 10^2 \\ \hline 340 \times 10^2 \end{array}$$

$$\text{or } \; 3.40 \times 10^4$$

Rule 4. - To multiply or divide:

a) Multiply or divide the decimal portions of the number.

b) If multiplying, algebraically add the powers of 10

c) If dividing, change the sign of the power of 10 of the divisor, then algebraically add.

Examples:

$$(2 \times 10^3)\ (3 \times 10^4) = 6 \times 10^{3+4} = 6 \times 10^7$$

$$(8.1 \times 10^3)\ (4 \times 10^{-2}) = 32.4 \times 10^{3-2} = 32.4 \times 10^1 \text{ or } 3.24 \times 10^2$$

SOLVING MATH PROBLEMS: The Criss-Cross Solution

In treatment plant operations, equations are used to calculate detention time of a tank, flow rate in a channel, filter loading rate, or chlorine dosage. To solve these equations, you must first make sure you have enough information.

For example, to solve for an unknown value, you must know the equation to use and you must know the values for all but one of the terms in the equation. This is important: **Only one term can be "missing" from the equation.** Otherwise, you don't have enough information to solve the problem.

For example, to calculate flow rate, you use the equation **Q=AV**, where **Q** = flow rate, **A** = area, and **V** = velocity.

TERMS

The **terms** of the equation are **Q**, **A**, and **V**. To use the equation, you must be given values to substitute for any two of the three terms. The term that you don't know is called the **unknown value** or merely the **unknown**. The unknown value is often represented by the letter **x**, but any letter can be used.

Most equations used in water treatment use multiplication and division, so this article concentrates on how to solve for the unknowns in these types of equations.

SOLVING FOR X

To solve for the unknown term in an equation using multiplication and division, you must rearrange the terms so that **x** is by itself. This often involves two steps:

1. Move **x** to the numerator (top) of the fraction if it is not already there.
2. Move all terms away from **x** to the other side of the equal-sign, so that **x** stands alone.

Of course, you can't just start rearranging the equation. You need to be sure that the equation remains true. There is **only one way** to do this: follow the "criss-cross rule":

To move a term from one side of the equal-sign to the other, move it from the top of one side to the bottom of the other side, or from the bottom of one side to the top of the other side.

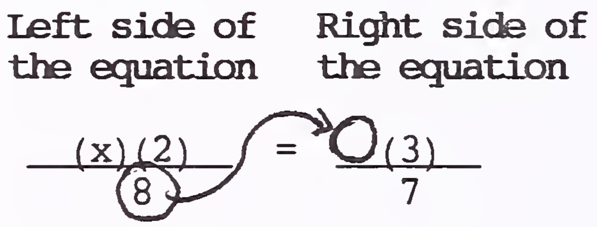
Any term in an equation can be moved if it is moved according to the criss-cross rule - terms cannot be moved any other way. Examples 1 and 2 show how to rearrange terms.

EXAMPLE 1

Given the equation below, move the 8 to another position.

$$\frac{(x)(2)}{8} = \frac{3}{7}$$

According to the criss-cross rule, there is only one possible way to move the 8. It must be moved to the top of the right side of the equation.



After this move, the equation is

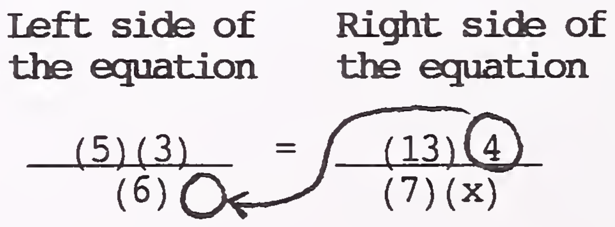
$$(x)(2) = \frac{(8)(3)}{7}$$

EXAMPLE 2

In the following equation, move the 4 to another position.

$$\frac{(5)(3)}{6} = \frac{(13)4}{(7)(x)}$$

There is only one possible move for the 4. According to the criss-cross rule, it must be moved to the bottom of the left side of the equation.



After this move, the equation is

$$\frac{(5)(3)}{(6)(4)} = \frac{13}{(7)(x)}$$

Rearranging the terms always involves this diagonal pattern. Any other movement is not permitted. The following three examples show how terms can be arranged to solve for the unknown value.

EXAMPLE 3

$$\frac{X}{7} = \frac{(2)(3)}{13}$$

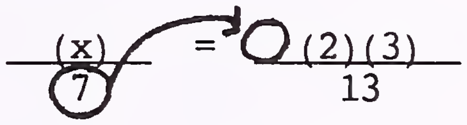
To solve for the unknown **x** in this equation, you must first ask yourself

- Is **x** in the numerator?

The answer is yes. Then ask yourself

- Is **x** by itself?

The answer is no. Since **x** is not by itself, some rearranging is necessary.



$$\frac{(x)}{7} = \frac{(2)(3)}{13}$$

$$x = \frac{(7)(2)(3)}{13}$$

Now that **x** is by itself, arithmetic completes the problem.

$$x = \frac{42}{13}$$

$$x = 3.23$$

EXAMPLE 4

$$\frac{3(B)}{4} = \frac{(6)(5)}{7}$$

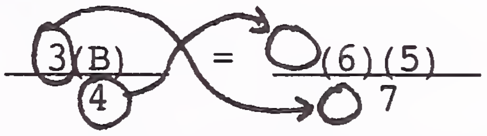
Again you must consider the two questions:

- First, is **B** in the numerator?

The answer is yes.

- Is **B** by itself?

The answer is no. Since **B** is not by itself, some rearrangement is necessary. The 3 and 4 must be moved away from **B.**



$$\frac{3(B)}{4} = \frac{(6)(5)}{7}$$

$$B = \frac{(4)(6)(5)}{(3)(7)}$$

The unknown **B** is now by itself, and arithmetic completes the problem.

$$B = \frac{120}{21}$$

$$B = 5.71$$

EXAMPLE 5

$$\frac{2}{(3)(y)} = (7)(3)$$

Consider again the first question:

- Is **y** in the numerator?

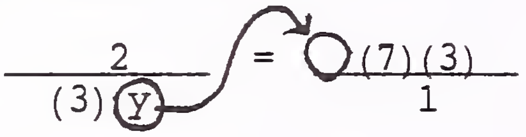
The answer is no and so it must be moved.

Before rearranging terms, make the right side of the equation into a fraction by putting a 1 as the denominator (bottom of a fraction).

This is a rule of math: You can make any number into a fraction simply by putting a 1 under it. Thus, 7 = 7/1; 3 = 3/1; (7)(3) = (7)(3)/1. This does not change the value, and it makes the criss-cross rearrangement more apparent.

$$\frac{2}{(3)(y)} = \frac{(7)(3)}{1}$$

Now move the y according to the criss-cross rule:



$$\frac{2}{(3)(y)} = \frac{(7)(3)}{1}$$

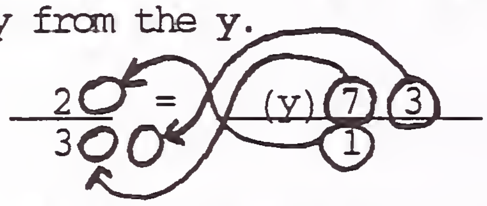
The resulting equation is

$$\frac{2}{3} = \frac{(y)(7)(3)}{1}$$

The unknown is in the numerator, so ask the second question:

- Is y by itself?

The answer is no. Since y is not by itself, some rearranging is necessary. The 7, 3, and 1 must be moved away from the y.



$$\frac{2}{3} = \frac{(y)(7)(3)}{1}$$

The resulting equation is

$$\frac{(2)(1)}{(3)(3)(7)} = y$$

The unknown is by itself and the problem can be completed using arithmetic:

$$\frac{2}{63} = y$$

$$0.03 = y$$

Solving for an unknown is the first step toward mastering any type of math problem. Waterworks math includes many such problems. Armed with enough information, the criss-cross rule, and basic arithmetic, you will be able to solve them.

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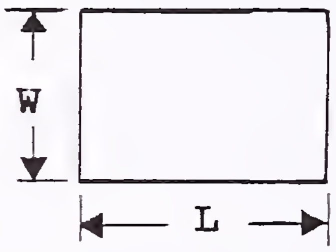
AREA CALCULATIONS:

Consider for a moment the physical property of area. Intuitively we all understand the concept of area and we know that it is measured in two dimensions, that is, it is a combination of the basic unit of length. The unit of measure for area is length squared. Examples include the square mile (mi^2), the square foot (ft^2), and the square meter (m^2).

Find the area of this rectangle:



Given W=2 ft and L=3 ft

Area= WxL = 2ft x 3ft =6ft^2

What is the above area converted to square inches (in^2):

$$W = 2ft \times \frac{12\ inches}{1\ ft} = 24\ inches$$

$$L = 3ft \times \frac{12\ inches}{1\ ft} = 36\ inches$$

Area= WxL = 24 in x 36 in =864 in^2

An alternative method for converting from square feet (ft^2) to square inches (in^2) is as follows:

$$1\ ft^2 = \left(1\cancel{ft} \times \frac{12in}{1\cancel{ft}}\right) \times \left(1\cancel{ft} \times \frac{12in}{1\cancel{ft}}\right)$$

$$1\ ft^2 = \frac{144\ in^2}{1\ ft^2}$$

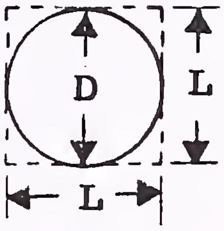
$$\textbf{Area} = 6\ ft^2 = 6\cancel{ft^2} \times \frac{144 in^2}{1\ \cancel{ft^2}} = 864\ in^2$$

What is the area if:

W = 3 meters and L = 5 meters

Area = W x L = 3m x 5m = 15 m^2

Find the area of this circle:



The area of a circle is approximately equal to three quarters the area of a square drawn about the circle (L = D).

The equation for the area of a circle is:

$\text{Area} = .785 \times L \times L = .785 \times D \times D$

$\text{Area} = .785 \times D^2$ (or $\pi D^2/4$)

So for D = 4ft

Area =.785 x 4ft x 4ft = 12.6 ft^2

What is the above area of the circle converted to inches:

$$D = 4ft = 4\cancel{f}t \times \frac{12inch}{1\cancel{f}t} = 48inches$$

So.....

Area = .785 x 48in x 48in = 1808in^2

Using the alternative method of converting:

$$\textbf{Area} = 12.6\ \cancel{f}t^2 \times \frac{144in^2}{1\cancel{f}t^2} = 1808in^2$$

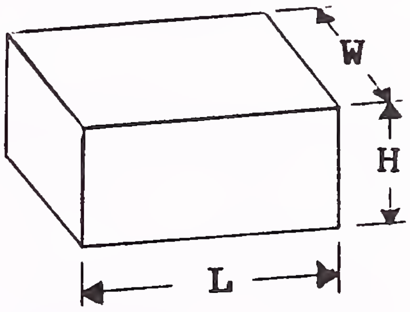
If D = 3 meters:

Area = .785 x 3m x 3m = 7.1m^2

VOLUME CALCULATIONS:

Volume is a measure of the space occupied by matter. It is measured in three dimensions or in cubic lengths, such as cubic feet(ft^3), cubic yard(yd^3), and cubic meter(m^3). Other commonly used units of volume include the gallon and quart in the english system and the liter(L) and milliliter(ml) in the metric system. These units can be converted to cubic units using the following conversion factors: 7.5 gallons equals 1 cubic foot(ft^3) and 1 liter equals 1000 cubic centimeters(cm^3).

Consider the rectangle from the area example calculation and add a third dimension height(H). We now have a box with a volume of LxWxH cubic length (or area x H). If we do the same to the area of the circle in the previous example we have a cylinder with a volume of .785xDxDxH cubic length.



Find the volume of the above box:

If W = 2ft, L = 3ft, H = 4ft

Volume = W x L x H

Volume = 2ft x 3ft x 4ft = 24ft^3

Convert this volume to gallons:

$1ft^3$ = 7.5 gal. So..

$$\textbf{Volume} = 24ft^3 = 24\cancel{f}t^3 \times \frac{7.5\ gal}{1\cancel{f}t^3} =$$

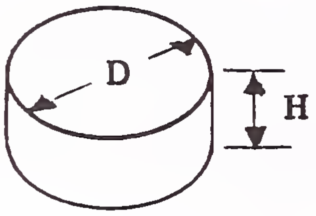
180 gal.

Now convert gallons to liters just for fun:

1 gal = 3.785 liters (L)

$$\text{Volume} = 180\text{gal} = 180\cancel{\text{gal}} \times \frac{3.785\ \text{L}}{1\ \cancel{\text{gal}}}$$

$$= 681.3\ \text{liters}$$



Find the volume of the above cylinder:

If D = 4ft and H = 5ft

Volume =.785 x D x D x H

$$\text{Volume} = .785 \times 4\text{ft} \times 4\text{ft} \times 5\text{ft} = 62.8\text{ft}^3$$

Convert this volume to gallons:

$1\text{ft}^3 = 7.5$ gal So..

$$\text{Volume} = 62.8\text{ft}^3 = 62.8\cancel{\text{ft}^3} \times \frac{7.5\ \text{gal}}{1\cancel{\text{ft}^3}}$$

= 471 gal.

Now convert gallons to liters just for fun:

1 gal = 3.785 liters (L)

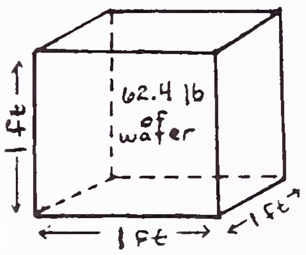
$$\text{Volume} = 471\ \text{gal} = 471\ \cancel{\text{gal}} \times \frac{3.785\ \text{L}}{1\ \cancel{\text{gal}}}$$

= 1782.7 liters

PSI OR FEET OF HEAD?

When we talk about pressures within a water system, we talk in terms of "psi" (pounds per square inch) or "feet of head" (height of water measured in feet). Generally our water consumers can relate to the commonly used term "psi". They know that a pressure of 60 psi at their tap will provide a more enjoyable shower than if only 15 psi is available. In contrast, the use of 138.6 feet of head and 34.65 feet of head for these pressure values would only confuse consumers and make them wonder what anatomy had to do with water pressure!

When we perform hydraulic calculations for water systems, it is generally easier to work with "feet of head" as our units and convert to "psi" at the end of our problem. The conversion factor that we need to remember is 2.31. That is, for each 2.31 "feet of head" in our water system, we have one psi of pressure.



This conversion factor is derived from the density of water of $62.4\ \frac{\text{lb}}{\text{ft}^3}$ causing a force of 62.4 lb pushing down on the square foot surface area.

Pressure in pounds per square inch can therefore be determined by converting pounds per square foot to pounds per square inch:

$$62.4\ \frac{\text{lb}}{\text{ft}^2} = \frac{62.4\ \text{lb}}{(\text{ft})(\text{ft})} =$$

$$\frac{62.4\ \text{lb}}{(12\ \text{in})(12\ \text{in})} = \frac{62.4\ \text{lb}}{144\ \text{in}}$$

So:

$$62.4\ \frac{\text{lb}}{\text{ft}^2} = 0.433\ \frac{\text{lb}}{\text{in}^2}$$

Since 1 ft of water height is equal to 0.433 psi, you can determine how many feet are equal to one psi by setting up a ratio and using the criss-cross rule:

$$\frac{1\text{ft}}{.433\text{ psi}} = \frac{x\text{ ft}}{1\text{ psi}}$$

$$(x\text{ ft})(.433\text{ psi}) = (1\text{ ft})(1\text{ psi})$$

$$x\text{ ft} = \frac{(1\text{ft})(1\text{psi})}{.433\text{ psi}}$$

$$x = 2.31$$

so: 1 psi = 2.31 feet of head and 1 ft of head = 0.433 psi

We can convert a height in "feet of head" to "psi" by dividing our "feet of head" value by 2.31:

$$\text{number of feet of head} \div 2.31\ \frac{\text{ft}}{\text{psi}} = \text{number of psi}$$

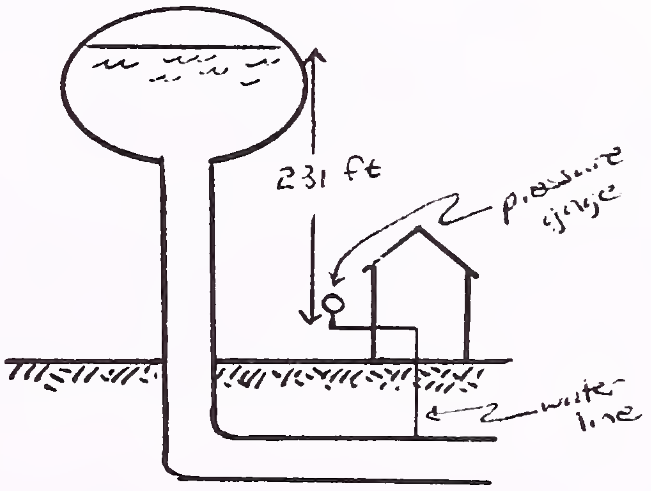
Similarly, we can convert from "psi" to "feet of head" as follows:

$$\text{number of psi} \times 2.31\ \frac{\text{ft}}{\text{psi}} = \text{number of feet of head}$$

As an example, assume that the elevation difference between a home and the water level in the storage tank that directly serves it is 231 feet. The pressure at the home is therefore:

$$231\ \cancel{\text{ft}} \times \frac{1\text{ psi}}{2.31\ \cancel{\text{ft}}} = 100\text{ psi}$$

(of course this excludes frictional losses)



Mathematics to disinfect by . . .

By: Michele Marsh
Robert Peccia & Associates

We all know that chorine disinfection of our water systems is an unavoidable part of our operation and maintenance procedures. Whether it entails a well, a storage tank, or a section of the distribution system, disinfection requires mathematics to obtain the proper chlorine dosages. The general mathematical steps taken for each disinfection situation are as follows:

1. Determine the volume of the system to be disinfected.
2. Determine the pounds of required chlorine
3. Determine the amount of chlorine product required.

In order to illustrate the mathematics necessary for disinfection problems, we will go through an example. We will disinfect the caisson for the Fort Benton water supply, which is described in another article of this Clearwater issue. In accordance with the general mathematical steps outlined above, we will calculate the amount of bleach necessary to disinfect the caisson.

Problem Details

height of caisson (h) = 15'
radius of caisson (r) = 6.5'
desired chlorine concentration for disinfection = 50 ppm
chlorine product to be used - bleach (with 5% effective chlorine)

Step 1: Determine the volume of the cylindrical caisson. Remember that all of your height and radius measurements must be in terms of "feet". In this problem they are already provided as "number of feet".

$$\begin{aligned}\text{Volume} &= \text{circular area} \times \text{height} \\ &= \pi r^2 \times h \\ &= \pi(6.5')^2 \times 15' \\ &= 1{,}991 \text{ ft}^3\end{aligned}$$

Convert ft^3 to gallons using the equation:

$$1 \text{ ft}^3 = 7.48 \text{ gallons}$$

$$\text{so:}\quad 1{,}991 \text{ ft}^3 \times \frac{7.48 \text{ gallons}}{1 \text{ ft}^3} = 14{,}893 \text{ gallons}$$

Step 2: Determine the pounds of chlorine required:

lbs chlorine = disinfection level (ppm) x caisson volume (million gallons) x 8.34 lbs per gallon

$$= 50 \text{ ppm} \times \frac{14{,}893 \text{ gallons}}{1{,}000{,}000 \text{ gallons/million gallons}} \times \frac{8.34 \text{ lbs.}}{\text{gallons}}$$

$$= \underline{\underline{6.21 \text{ lbs chlorine}}}$$

Step 3: Determine total gallons of bleach required:

$$\text{Total gallons of bleach} = \frac{\text{total lbs of chlorine required}}{(\text{effective chlorine}) \times 8.34 \text{ lbs/gal}}$$

$$= \frac{6.21 \text{ lbs of chlorine required}}{0.05 \times 8.34 \text{ lbs/gal}}$$

$$= \underline{\underline{14.9 \text{ gallons of bleach}}}$$

Some helpful points to remember when working problems such as this:

- Always keep track of units. (Ex: $\frac{\text{Gal}}{\text{FT}^3} \times \text{FT}^3 = \text{GAL}$)
- Keep work neat and organized.
- Percent is actually parts per hundred. (Ex: 5% = .05)
- "ppm" represents "parts per million" and when it is used in an equation, this must be acknowledged.

* *

O & M EXCELLENCE AWARDS PROGRAM

Montana has shown the nation we have outstanding operation and maintenance programs. This was done by having four regional winners in EPA's O & M Excellence Awards Program. Lewistown, Polson, and Superior won O & M Awards and Bozeman won an award for beneficial use of sludge.

This awards program is intended to highlight effective local operation and maintenance programs and increase public awareness of wastewater treatment facility contributions to clean water and sludge land application. The EPA program recognizes the commitment by local officials and plant personnel to maintain and protect the nation's environmental infrastructure.

If you are interested in nominating the wastewater treatment facility in your community for one of these awards, please contact Dick Pedersen of the Water Quality Bureau at 444-2406.

FACULTATIVE LAGOON STORAGE CAPACITY

by Dick Pedersen

It is fairly typical for Montana's facultative lagoons to experience discharge permit violations from February through June. The worst quality effluent usually occurs right after the lagoon ice melts. Often this is followed by "pond turnover" which occurs when the temperature gradient from the surface to the bottom of the lagoon is such that the water on top will sink and the water on the bottom will rise to the surface. Unfortunately, when the water on the bottom rises to the surface all the gunk (sludge) comes with it. This results in those spring time odors and poor effluent quality. This condition may last for several weeks.

Some lagoon facilities also experience a poor quality effluent in late summer. This is primarily due to algae growth (pea soup) in the lagoon. This condition may last for 1 or 2 months depending on the weather and loading conditions to the lagoon.

Probably the most important operational tool available to operators to prevent violations of permit limits is the ability to hold wastewater and not discharge during periods of poor treatment. This requires that the operator draw down the lagoon far enough to be able to hold the wastewater during those periods. One important thing to keep in mind is that any draw down must be in compliance and meet the limitations of the discharge permit. To be safe, it is advisable to contact the Water Quality Bureau before starting your draw down.

The first thing an operator must do is determine which period of time the effluent is likely to exceed the limitations of the permit. This can be done be looking over past discharge records. Once you determine which period of time not to discharge you must decide how far or when to draw down. The first step is to figure out the capacity of each foot of draw down in your lagoon as follows:

surface area (acres) x 43,560 sq ft/acre = surface area (sq ft)

surface area (sq ft) x 1 foot draw down = cubic feet per ft dd

cubic feet x 7.48 gallons/cu. ft. = gallons per foot draw down

for example:

10 acre lagoon x 43,560 = 435,600 square feet surface area

435,600 sq ft x 1 = 435,600 cubic feet in 1 foot draw down

435,600 cu ft x 7.48 gal/cu ft = 3,258,000 gals per foot

Once you have determined how many gallons are in each foot of draw down you must then figure out how much wastewater is flowing in to your lagoon. If you are lucky you have influent flow data but usually this data does not exist. You can use effluent flow data but this does not include any seepage or evaporation which can be significant. One fairly good method is to use a per capita flow contribution. A good rule of thumb is that each person in a community contributes 100 gallons per day to the lagoon. This allows for a minor amount of infiltration. If you have significant infiltration you will have to increase this number. To determine influent flow to our 10 acre lagoon which serves a population of 765 (ask the town clerk for population) we would:

765 people x 100 gal. per person per day = 76,500 gal. per day influent

Once we have determined our lagoon capacity and our influent flow we can easily determine how many days of storage are in each foot of draw down. For our 10 acre lagoon this would be done as follows:

$$\frac{\text{3,258,000 gal. per foot}}{\text{76,500 gal. per day}} = \text{42.5 days storage per foot of draw down.}$$

Typically, you have about 3 feet of draw down available in your facultative lagoon. A lagoon is usually 5 feet deep but you should never draw it down below 2 feet because the quality of wastewater in that bottom 2 feet is usually poor and can not meet permit conditions. So in 3 feet of draw down I have a total storage capacity of:

3 x 42.5 days = 127.5 days

If I determined earlier that the period of time I am likely to violate permit limits is from March 1 to June 30 then I must not discharge during this time. This is a period of 122 days. If I have 127.5 days capacity in 3 feet than I must be drawn down to the 2 foot level by March 1.

It is advisable to draw your lagoon down over a long period of time, preferably 1 to 3 months. For my 10 acre lagoon example I would begin draw down in December or January. Once draw down is complete I would monitor the lagoon level to make sure my influent flow calculations were correct. If they were it should take approximately 40 days to fill 1 foot.

One final note, make sure you write down all of your calculations so you can use them in following years.

Report to Montana AWWA Members

MONTANA SECTION
AMERICAN WATER WORKS ASSOCIATION

By: Gerald Lukasik, Chairman

Last April I attended the Region 5 meeting for section officers in Minneapolis. The meeting was very informative and covered AWWA objectives, organization, finances, legislative issues, and many other facets of the Association. The regional meetings will continue on a yearly basis. A five-year rotational schedule has been established for the Region 5 sections. Montana will host the regional meeting in 1992. Good luck in 1992, Dan.

The 1990 Joint Conference in Bozeman is fast approaching and many committee members are working very diligently to see that the conference is a big a success as in past years. The Host City Committee and Program Committee, chaired by Howard Peavey and Bob Hunter, have pretty much cleared all of the major hurdles and are doing an excellent job. The theme for the 1990 conference is "Montana Cleans Up."

Committee chairman should write a report on their committee activities and bring it to the conference in March. Budget requests should be included. If you cannot attend, you may mail your report to Paul Torok, Secretary/Treasurer, and P.O. box 503, Seeley Lake, MT 59868.

Many thanks to all committee members who are working to make our 1990 conference a success.

At our section meeting last September, the board, in an effort to increase membership, agreed to pay 50 percent of the first year's dues for new members and affiliates. Donna Howell will have a booth at the conference to recruit new members.

We have been in contact with the Montana Rural Water Association regarding the combining of our conferences. If an agreement can be reached, a triumvirate of MSAWWA, MRWA, and MWPCA would then hold a yearly conference. This arrangement will solve numerous problems involving scheduling, manufacturers representation, and attendance. Hopefully, we will meet with the MRWA in March for further discussion.

The Safe Drinking Water Act and subsequent new E.P.A. rules and regulations are complicating everyone's life in the water industry. The State of Montana is in danger of losing primacy unless more funding is made available for hiring additional personnel to carry out the various new programs. The MSAWWA and MRWA are jointly sending a letter to Governor Stephens which will express our concerns about additional State funding requirements and the negative impact of the loss of primacy.

The term of our current director, Ralph Dunahoo, expires at the 1990 Annual Conference in Cincinnati, Ohio. We will elect a new director at our section conference to replace Ralph, who has done an excellent job for the past three years. Orientation for incoming directors will be held in Cincinnati on Saturday, June 16.

National Drinking Water Week will be May 6-12, 1990. The national theme is the same as in 1989, "Drinking Water: on Tap for the Future." AWWA National will be sending out packets containing sample news releases, a policy statement, sample radio announcement, a sample proclamation to be used by mayors, commissioners, etc., and many other helpful ideas on how to celebrate National Drinking Water Week. The packets should be mailed out by the end of January.

The Montana Section will again be very fortunate in having the AWWA National President at our 1990 conference. Mr. Harry Snider will be present at our meeting in Bozeman. I'll see you in Bozeman in March.

METC UPDATE

by Dick Pedersen

1989 was an exciting year for the Montana Environmental Training Center (METC). You might say it was a year we got our feet off the ground. We are excited about accomplishments last year and look forward to what 1990 has to offer.

METC sponsored or co-sponsored 24 workshops in 1989. These workshops were held throughout the state stretching from Kalispell to Glendive. 471 water and wastewater professionals attended the 24 workshops which means the average attendance at each workshop was nearly 20 people. The workshop which had the most attendance was a Basic Water and Wastewater workshop held in Billings on February 22. The workshop had 47 participants.

1989 was a year in which METC purchased a lot of training equipment. We are most excited about the equipping of a water and wastewater lab located at Northern Montana College in Havre. This lab is now ready for training using the latest apparatus.

1989 was also the year we began negotiations with the City of Kalispell for the construction of a classroom at their wastewater treatment facility. Kalispell is currently in the design stages of a new wastewater treatment facility. The facility promises to be state of the art with the main treatment scheme being activated sludge with biological phosphorous removal. For a limited amount of money, METC can participate in the expansion of a conference room at the facility. This room would then be available for METC sponsored training.

1990 promises to be an exciting year. Most exciting is that we will have another person involved in water and wastewater training. This person will be responsible for coordinating METC activities set forth by the METC steering committee. He or she will be located in Great Falls but will be traveling statewide to METC workshops.

You should have all received the 1990 Training Calendar by now. As you will see, METC is sponsoring 30 workshops. We will be offering a lot of training in the public water supply field. With the changing regulations it is important to keep you all informed and up to date on operational methods necessary to meet these regulations. You wastewater folks don't fret because we have some exciting things in store for you also. Top of the list is a two-part workshop for mechanical treatment plants. This workshop will cover the basics and also more advanced topics.

The lending library has been updated and we plan to make it more accessible in 1990. We plan to bring library material with us to workshops and make it available for you to check out. We also will begin serious work on training modules with "Backflow/Cross Connections" and "Lagoons" being the first ones. We hope to have them completed this year.

These are just a few of the things happening with your organization. We welcome any of your ideas or suggestions, so feel free to call us any time. You can reach Donna Howell or Dick Pedersen at 444-2406 or Martha Dow or Doris Roberts at 265-3757.

NEWS...ABOUT CERTIFICATION

by Rosemary Fossum

RECENT APPOINTMENTS TO THE WATER AND WASTEWATER OPERATORS' ADVISORY COUNCIL are Mark Richardson, who is Public Utilities Director of the City of Miles City, and Stephen Ruhd, who is Assistant Water Superintendent of the City of Conrad. These council members have replaced Charles Dickert, Helena Water Treatment Plant Superintendent, and Greg Acton, Whitefish Superintendent of Water and Wastewater Plants, whose terms expired in October of 1988 and 1989, respectively. Others currently serving on the Advisory Council are David Brown, Environmental Consultant, Great Falls; Bob Butcher, Chief Chemist-Billings Water and Wastewater Treatment Plants; Gary Smith, Public Works Director, Cut Bank; Howard Peavy, MSU professor and Water Resource Center Director, Bozeman; and Steve Pilcher, Water Quality Bureau Chief, Helena. The council meets four times per year to advise and assist in the administration of the certification program, particularly in actions relating to the operator qualifications. Montana certified operators are extremely fortunate to have such highly qualified individuals who are essentially donating their time and assistance to help maintain and improve the certification program. Let them hear from you.

WHAT DO YOU KNOW ABOUT TRAINING BIENNIUMS? You should know that means a two-year training period during which continuing education credits must be earned. The current training biennium began July 1, 1988, and will end June 30, 1990. The next training biennium will begin July 1, 1990, and will end June 30, 1992. All Class 1-4 operators who became fully certified before October 1 of 1988 must complete the number of continuing education credits required for their certification during the current training biennium in order to renew this certification for the next fiscal year (July 1, 1990, through June 30, 1991). **If this seems hard to remember, try this: Every even-numbered year by June 30, completed CEC's AND fees are required for renewal. Every odd-numbered year by June 30, only fees are required for renewal. Wake up! Wake up! YOU'VE GOT TILL JUNE 30 TO GET YOUR CEC'S COMPLETED!**

SECTION 37-42-321 OF THE MONTANA CERTIFICATION LAW lists these conditions under which an operator's certificate may be revoked: (a) the operator has practiced fraud or deception; (b) reasonable care, judgement, or the application of operator knowledge or ability was not used in the performance of duties (c) the operator is incompetent or unable to properly perform duties. Question--would making up values on a Chlorine Residual Determination Report Form constitute "practicing fraud"? Mr. Webster defines fraud as "intentional perversion of the truth." We need to think about the fact that the main purpose of proper operation of public water and wastewater systems is to protect the public's health and safety and Montana's waters from being endangered. When reports designed as part of the proper operation process are not honestly completed, the operator may be risking the public's health and welfare and, in addition, his certification as an operator. Perhaps all certified operators should be reminded that even routine reports have meaning to proper plant or system operation for the public's health and safety, and therefore have meaning to the integrity of operator certification.

A NEW REGULATION FURTHER DEFINING ACTION TO BE TAKEN UNDER SECTION 37-42-321 is now undergoing legal review by the department. When the review is completed, the regulation will be supplied to all operators for review in advance of the required hearing for regulation changes and additions.

PASSING EXAMINATIONS FOR FULL CERTIFICATION OR OPERATOR-IN-TRAINING (OT) 9/29/89

Class 1:
William Anders, Havre, 1B-ot*
Scott Austin, Havre, 1B-ot*
Patrick Blatter, Great Falls, 1C-ot
Jack Brazill, Missoula, 1C
Michael Fredrickson, Havre, 1B-ot*
Kathy Hilts, Havre, 1B-ot*
Michael Jacobson, Great Falls, 1C-ot*
Jeff Jensen, Havre, 1B-ot*
Robert Kent, Butte, 1A, 1B-ot
Lloyd Lange, Missoula, 1C
Larry McGrail, Billings, 1B-ot
Anthony Reed, Havre, 1B-ot*
Victor Romano, Butte, 1A-ot,1B-ot
Terry Steigers, Missoula, 1C
Phillip Stewart, Havre, 1B-ot*
Tom Tauscher, Hardin, 1B
Bill Taylen, Bozeman, 1A-ot
Steve Theisen, Great Falls, 1B-ot*
Wayne Tomicich, Red Lodge, 1B-ot*
John Wanke, Great Falls, 1B
William Weaver, Havre, 1B-ot*
Brenda Wilson, Helena, 1B-ot*
Marvin Woelich, Forsyth, 1B-ot
Benton Van Dyke, Kalispell, 1C*

Class 2:
Everett Bauer, Billings, 2C*
Geanette Cebulski, Seeley Lake, 2B-ot
Eric Johnson, Bigfork, 2C*
Duane Frelich, Livingston, 2C
Dale Hyem, Billings, 2C
Don Kast, Willow Creek, 2C
Larry McGrail, Billings, 2A
David Peterson, Havre, 2A-ot
Ed Rasmussen, White Sulphur S.,2B*
Alan Scheer, Wolf Point, 2A3B*
Donald Stewart, St. Ignatius, 2C
Tom Tauscher, Hardin, 2C
Mike Voorhies, Libby, 2A
Keith Wilmes, Polson, 2A-ot,2B-ot*
Johnny Webb, Lewistown, 2C-ot
John Wells, Billings, 2C-ot
Francis Wright, Neihart, 2B-ot

Class 3:
Charles Bogle, Whitefish, 3C
Matthew Burden, W.Yellowstone,3A4B*
Donald Clarin, Circle, 3A4B-ot
Roger Giesy, Whitefish, 3A4B*
Tim Goldsberry, Bridger, 3A4B
T. G. Haggerty, Bozeman, 3C-ot
Lonnie Hansen, Libby, 3C
Randy Higgins, St. Mary's, 3A4B
William Hinerman, Whitefish, 3C
Howard Hogan, Alberton, 3C
James Jeffres, Kevin, 3A4B,
Greg Johnson, W. Yellowstone,3A4B*
Eric Johnson, Bigfork, 3A*
James Kallem, Glasgow, 3C-ot*
Johnny Lingle, Circle, 3A4B
Bernice Morgan, Vaughn, 3A4B*
Duke Nieskens, Glasgow, 3C*
Robert St. Clair, E. Helena, 3C-ot
Joseph Straka, Whitefish, 3A4B
Trudy Steinle, Decker, 3A4B*
John Wahoff, Gardiner, 3C
Edmund Ward, Missoula, 3C

Class 4:
Niki Aquilano, Bozeman, 4C-ot
Wendell Blount, Lakeside, 4AB, 4C
Geanette Cebulski, Seeley Lake, 4A-ot
Donald Clarin, Circle, 4C-ot
Fran Donges, Fort Smith, 4C*
David Durfee, Drummond, 4C-ot
Kelly D. Elser, Sheridan, 4C
John Field, Big Sandy, 4C-ot*
Tim Goldsberry, Bridger, 4C
James Jeffres, Kevin, 4C
Johnny Lingle, Circle, 4C-ot
Roger Nummerdor, Boulder,4AB, 4C
Kevin Osterberg, Havre, 4A-ot
Beverly Pepos, Stockett, 4AB-ot
Dennis Schaffer, Broadus, 4AB, 4C
Jack Stewart, Boulder, 4AB, 4C
Kevin Templer, Ronan, 4B*
Kenneth Truesdell, Townsend, 4C
Francis Wright, Neihart, 4B-ot

Class 5:
Lonnie Hansen, Libby, 5AB
Bill Hyman, Big Sky, 5AB
Cort Strobel, Big Timber, 5AB
Tom Tauscher, Hardin, 5AB

EXAMINATION NOTICE

ON SATURDAY----------MARCH 10,1990-----------------9:30 A.M.

Examinations for certification as a Water Distribution System Operator, Water Plant Operator and Wastewater Plant Operator will be given at these seven locations:

BILLINGS----- Lewis Room, Student Union Building, Eastern Montana College

GREAT FALLS-- NMC Great Falls Center, 1211 NW Bypass (eight blocks west of Shopko)

HAVRE-------- Room 103-4, Hagener Science Center, Northern Montana College

HELENA------- Room C209, Cogswell Building, (Use entrance from Broadway)

KALISPELL---- Room 37, Montana Hall, Flathead Valley Community College, 15 First St.E.

MILES CITY--- Room 106, Miles Community College, 2600 Dickinson, East of Vet's Hosp.

MISSOULA----- Room 102, Liberal Arts Building, University of Montana

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By February 23, as required by ARM 16.18.204, everyone taking examinations must have:

--completed an application for certification as a water/wastewater operator.
--paid application (or renewal) fees for fiscal year 90 which ends 6/30/90.
--submitted examination registration slips and fees of $5 per examination.

APPLICATION FEES ARE: Class 1-$27; Class 2-$22: Class 3-$17; Class 4-$12; Class 5-$10 To request application materials, order study materials, or ask for additional information call the certification office at 444-2691 or write: DHES-WATER QUALITY BUREAU;Water/Wastewater Operator Certification; Room A206, Cogswell Building, Helena, Mt. 59620. **RETAIN THE UPPER PORTION OF THIS NOTICE, PLEASE.**

EXAMINATION REGISTRATION SLIP

(Detach and return with $5 per examination by 2/23/90)

I will take the examination(s) I have checked below at: ___Billings; ___Great Falls; ___Havre; ___Helena; ___Kalispell; ___Miles City; ___Missoula

	1	2	3	4	5
A--Water Distribution	____	____	____	____	
B--Water Plant	____	____	____	____	____
C--Wastewater Plant	____	____	____	____	

*Combination examination 2A3B, 3A4B, 4A4B, and 5A5B require $5 exam fee only.

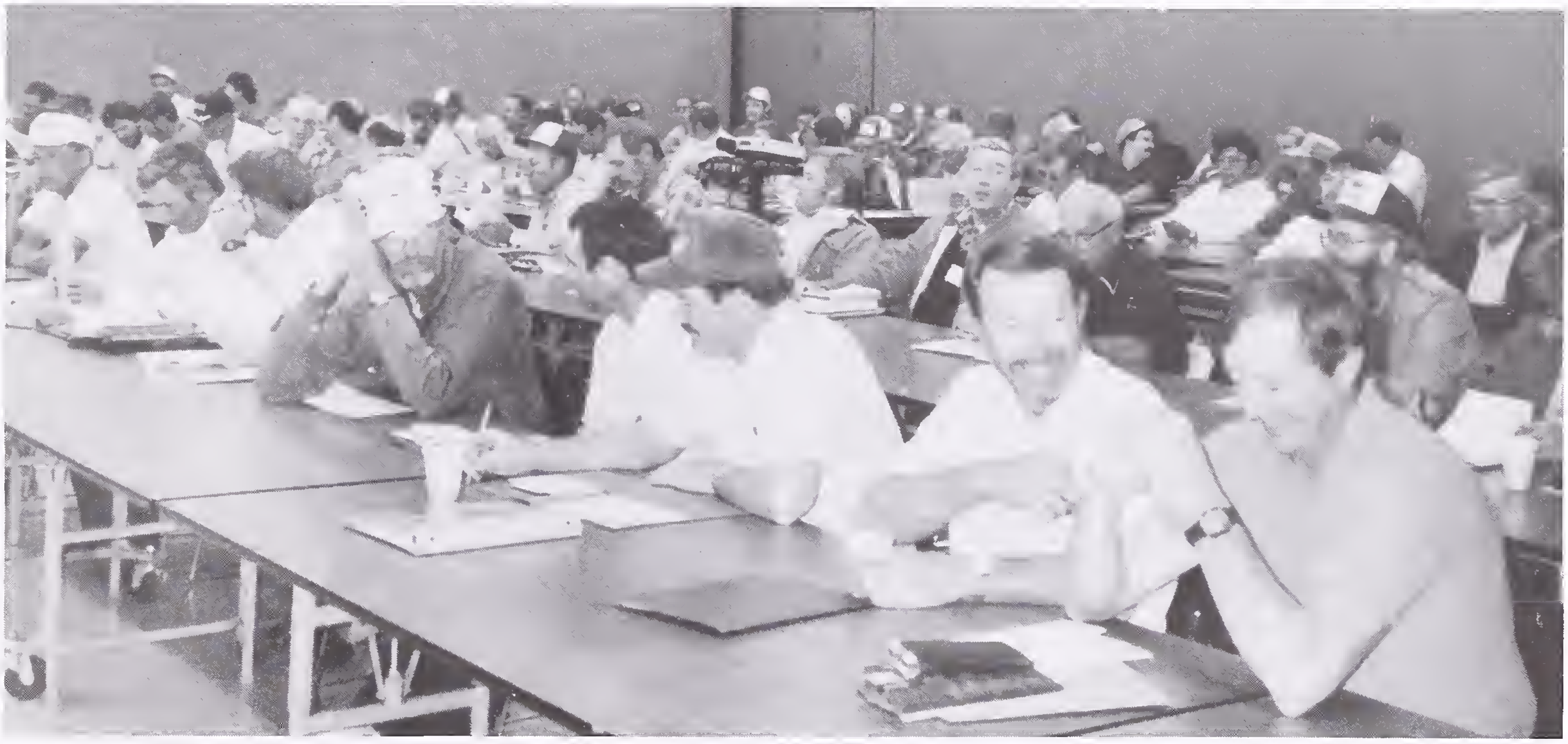
NAME________________ ADDRESS________________ SYSTEM________________

FIFTY-SIXTH ANNUAL WATER SCHOOL

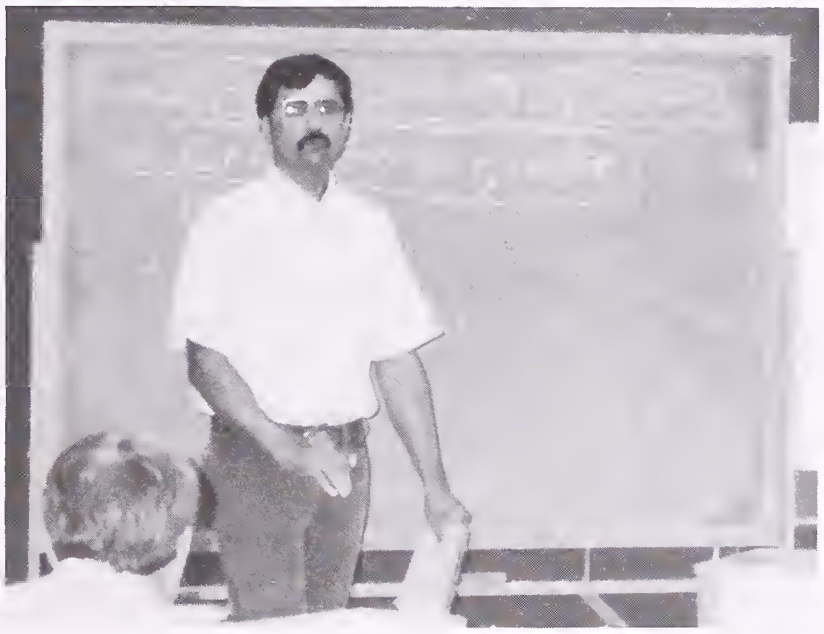
Over 150 water and wastewater professionals attended the 56th annual Water School for water and wastewater operators and managers. The school was held in Bozeman September 25-28, 1989. In addition to those already certified at the school nearly 100 took the certification exam on Friday.

Many timely and interesting topics were presented at the school. Once again the attendees came prepared to get involved in each and every session. It is this kind of commitment that makes the school the success it has been.

Following are some snapshots taken at the school.



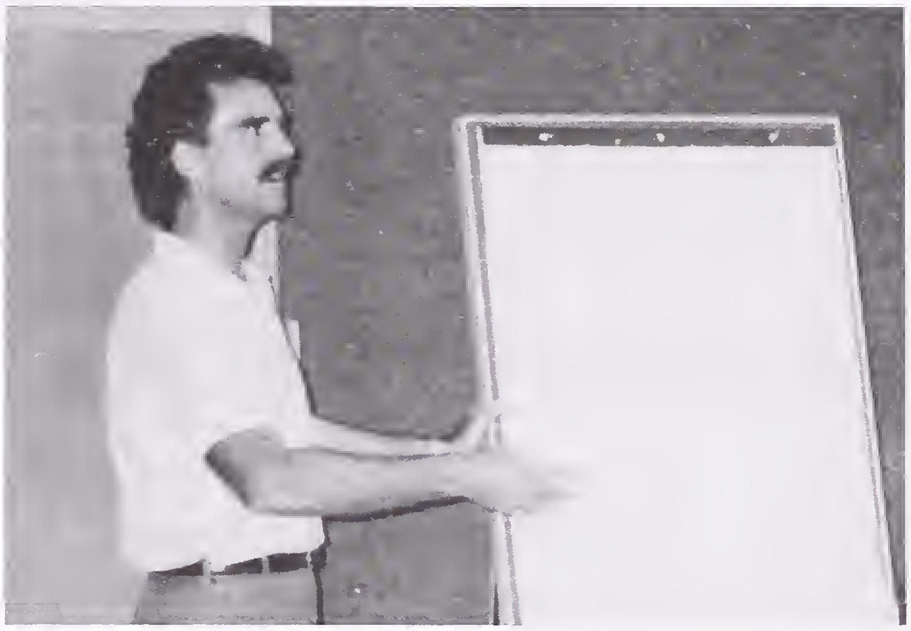
Ready to get started.



Joe Strasko, WQB, discusses wastewater compliance.

Jerry Jansma, City of Billings, looks over a map of Billings's distribution system.

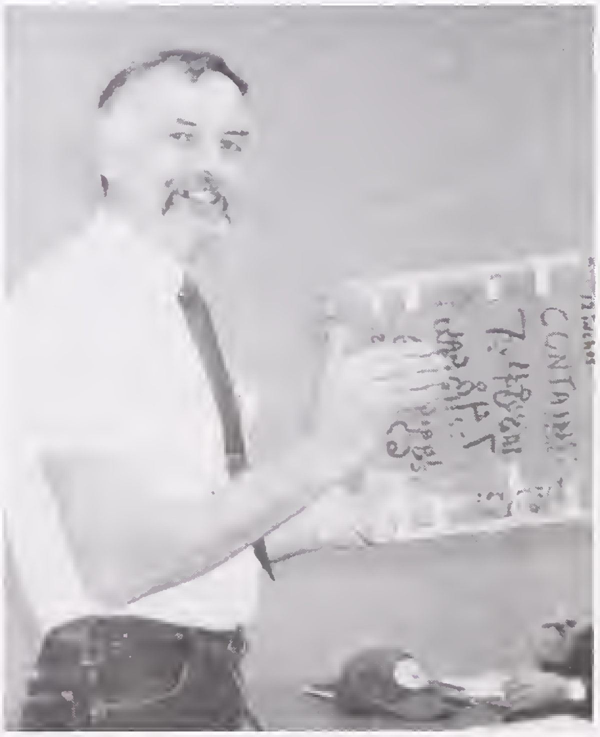
WQB's new training officer, Dave Aune, getting his feet wet.



Paul Klopping of ETC gets deep in to activated sludge.

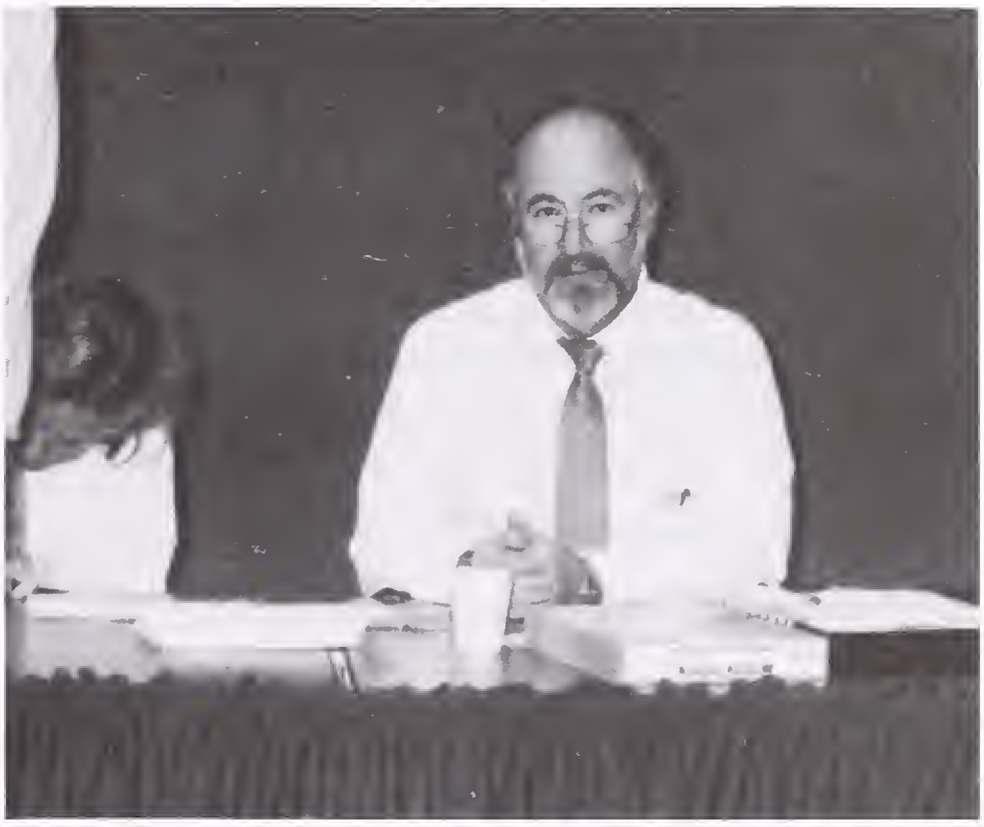
The line up.

Water Filtration by Kate Miller, WQB.



Steve Cheman, Evergreen, and his "box of water".

Elston Loken, Town of Ekalaka, anxiously waiting for the Safety session.



"Registration is finally over!" says Howard Peavy.

Certification as presented by Rosemary Fossum, WQB, always commands a captive audience.

Joe Scheeler of Capitol Controls discusses chlorination.

Montana's Progress
Toward Implementation of the
1986 Amendments to the Safe Drinking Water Act

An informal discussion by Dan Fraser, Public Water Supply Program Manager

I'm sure all of you are aware of the sweeping changes mandated by the 1986 Amendments to the SDWA. You probably also have a pretty fair idea of how some of those changes may impact your utility and your water users' bills. As you might guess, the amendments will also have a dramatic affect upon Montana's Public Water Supply Program. The purpose of this article is to let you know where our program stands in terms of: (a) implementation of the new requirements; (b) retaining primacy for the federal program; and (c) the implications of loss of primacy.

First of all, 'we ain't very damn far' in terms of implementing the new requirements of the amendments. The accompanying standard setting schedule shows that, in order to continue meeting EPA's conditions for maintaining primacy, Montana should have already promulgated new rules for fluoride, volatile organic contaminants (VOC) and public notification (PN). The fact of the matter is we haven't even begun to write the rules and we haven't for what we believe to be very sound reasons. We currently do not have enough resources to properly implement the rules we have in place. Our most recent needs assessment indicates our program would have to have a 40% to 70% increase in funding and staff just to properly handle the existing requirements. Therefore, the department has taken the position that it would not be responsible to write new rules that we would have no hope of implementing.

That leads us to the second subject regarding where are we in terms of retaining primacy for the federal program. Simply put, we stand to lose primacy for the program and the federal grant funds that accompany primacy. EPA has started making noises (grunts and wheezes), shuffling and bobbing and weaving just as if they plan to take primacy from Montana. EPA doesn't have a reputation of "floating like a butterfly and stinging like a bee" but, frankly, if the state isn't able to show them that we intend to maintain the program and provide reasonable support for it, they won't have any choice. The ugly truth is that when Congress mandates such extensive regulatory changes, it costs a bunch for water systems and state programs to comply. In both cases it is Joe Citizen who pays the bill. Are the mandated changes worth the cost? That is a subject for another article to be written at a later day by someone who knows more than I do.

Now let me give you my opinion of the ramifications of the potential loss of primacy. First of all we would lose about $500,000.00 in federal grant funds that are currently used to support the state program. That means we would be left with approximately $120,000.00 left to support a program that is already grossly under-funded. Losing primacy and federal funding does not remove the current program responsibilities. Therefore, the state would have two alternatives: (a) dig up the additional dollars necessary to handle the program via special fees or general funds; or (b) repeal and/or amend existing laws and regulations to reduce or eliminate parts or all of the department's existing responsibilities regarding public water systems. If the choice is to fund only the state program as it now exists it most likely that this would cost the state more than it would to provide the additional funding necessary to maintain primacy (an additional half million dollars just to maintain status quo). If, on the other hand, the state were to repeal and/or amend existing laws and regulations to eliminate responsibilities, there are a number of activities the state has historically supported that may have to be eliminated or curtailed. Those would include review of engineering plans, operator training, sanitary surveys, inspections, technical assistance to water systems, response to public requests for information and assistance, and, assistance to systems with contaminated water or other public health risks. Is this in the best interest of public health??

The choices don't appear to be simple or desirable. We are, however, at a point where a decision has to be made.

^^^

DRINKING WATER STANDARD SETTING SCHEDULE *

CONTAMINANT/REQUIREMENT	FINAL RULE**	EFFECTIVE DATE***
FLUORIDE	4/86	10/87
LEAD BAN (SDWA 1417)	6/86	6/86
PHASE I VOLATILE ORGANICS	6/87	1/89
PUBLIC NOTIFICATION	10/87	4/89
LEAD BAN POLICY GUIDANCE	9/88	3/89
SURFACE WATER TREATMENT RULE	6/89	12/90
TOTAL COLIFORM RULE	6/89	12/90
LEAD/COPPER	11/90	5/92
PHASE II 38 CONTAMINANTS	12/90	6/92
PHASE III RADIONUCLIDES	9/91	3/93
PHASE IV DISINFECTION	FALL 92	SPRING 94
PHASE V 25 CONTAMINANTS	3/91	9/92
PHASE VI 1ST LIST 25 CONTAMINANTS	WINTER 91	SUMMER 92
2ND LIST 25 CONTAMINANTS	WINTER 94	SUMMER 95

* AS OF NOVEMBER 1989

** ALL DATES AFTER JANUARY 1990 ARE ESTIMATED

*** EPA RULES ARE GENERALLY EFFECTIVE 18 MONTHS AFTER BEING FINALIZED. STATE RULES ARE REQUIRED TO BE ADOPTED BY THE EPA EFFECTIVE DATE. SOME OF THESE DATES ARE NOW COURT-ORDERED COMPLIANCE DATES EPA IS REQUIRED TO MEET.

CHLORINATED SOLVENT CONTAMINATION OF A PUBLIC WATER SUPPLY

Phase I - what, where, and when, but not who or how

By: Nick Bugosh, Water Quality Bureau

A new program of survey sampling of public water supplies for chlorinated solvents revealed, during the summer of 1989, that a public water supply system in Bozeman, Montana was contaminated. The four-well system served a small trailer park in town. The primary contaminant was tetrachloroethylene, also known as perchlor, perchloroethylene, perc, perclene or PCE. This article reports the Department of Health and Environmental Science's (DHES) initial response to the discovery of contamination and discusses the implications of this incident to other public water supplies.

WHAT IS TETRACHLOROETHYLENE (PCE) ?

PCE is a man-made chlorinated organic solvent. An organic solvent is carbon based, which means that PCE can readily dissolve other carbon based materials. Since carbon is a fundamental building block of life on earth, PCE can dissolve a wide variety of substances, such as oils and wax, that are formed from once living things. Chlorinated means that chlorine, a very powerful oxidizer, is a part of PCE added to increase its solvent power. The resultant chemical is a very powerful solvent that can easily dissolve a wide variety of substances in the natural world. This property explains the fact that approximately 53% of the PCE manufactured is used by the dry cleaning and textile industry. The remaining PCE use is for: industrial metal cleaning (10%); manufacturing other chemicals (28%); export (5%); and other uses (4%).

IS THERE A PUBLIC HEALTH CONCERN ASSOCIATED WITH TETRACHLOROETHYLENE (PCE) ?

PCE is known to be toxic to humans. The principal target organs are the central nervous system, liver and kidneys. PCE is considered to be a probable human carcinogen; long term exposure to PCE may increase the risk of cancer in humans. Animal studies also suggest that PCE has the potential to cause developmental effects on fetuses and toxicity to pregnant animals.

PCE may enter the body by ingestion, inhalation or absorption through the skin. The inhalation route has been documented most often to result in toxic effects in humans. Because PCE is very volatile it vaporizes readily; this vaporization can be enhanced by boiling or by aerating, for example, when running water for a shower.

THE DEPARTMENT OF HEALTH AND ENVIRONMENTAL SCIENCES RESPONDS

PCE was detected at 264 and 714 micrograms per liter (µg/l) in the trailer court wells. The unit "micrograms per liter" is equivalent to "parts per billion" (µg/l=ppb). Less than one ounce of contaminant in one million gallons of water yields micrograms per liter concentration. The DHES considered the detection of PCE at the hundreds of micrograms per liter level in well water a threat to public health, based upon published information and a proposed maximum contaminant level of 5.0 µg/l.

Phase I of the response

The DHES Water Quality Bureau (WQB), with the cooperation of the Gallatin County Health Department, began a public information effort to alert potentially affected users to the hazards associated with using the contaminated water. The Safe Drinking Water section of the WQB participated in a public meeting in the Gallatin County courthouse in Bozeman to discuss the problem and recommend alternate sources of potable water. The public was advised that all uses, including drinking, cooking, dish washing and bathing, be discontinued. Alternate sources available included hooking up to the Bozeman city water supply and purchasing bottled water. The public was asked to come forward with information on locations of wells in the area and any clues they might have regarding the source of the contamination.

The WQB Permits section groundwater staff simultaneously initiated an effort to delineate the affected area and identify possible sources of contamination. The staff gathered information volunteered by the public to aid in the tasks of identifying the extent of aquifer contamination, routes of contaminant migration into the groundwater and the source of the contamination. Other sources of existing information were searched. These included the Department of Natural Resources and Conservation well log catalog and an aquifer study conducted by a Montana State University graduate student. These existing sources allowed the relatively rapid and inexpensive characterization of the aquifer and contaminant plume without drilling monitoring wells.

How much of the aquifer was contaminated?

The existing wells in the area were sampled and the samples analyzed for tetrachloroethylene, trichloroethylene, dichloroethylene and chloroform, all of which had been detected in the survey sampling. Twenty-eight samples were obtained to roughly define the extent of the contamination plume. The accompanying analysis cost was approximately $180 dollars each, or $5,040 total, for this effort. The cost for this information would have been much higher and the time to obtain it much longer had new monitoring wells been installed. An additional benefit of sampling existing drinking water wells was that the quality of each domestic well was positively determined. The trailer court elected to hook up to the city water supply and the state continued sampling this public water supply to determine if the contaminants had been flushed from the supply lines; another twelve samples were collected at an approximate analyses cost of $2,160. By early October the emerging picture showed the contaminant plume to be about 1,000 feet wide (includes about three city blocks), but the length of the plume was indeterminate. Additional wells were located and sampled, and by November it appeared that the length of the plume was about 1.3 miles. The aquifer underlying about 0.25 square miles was contaminated (See figure 1).

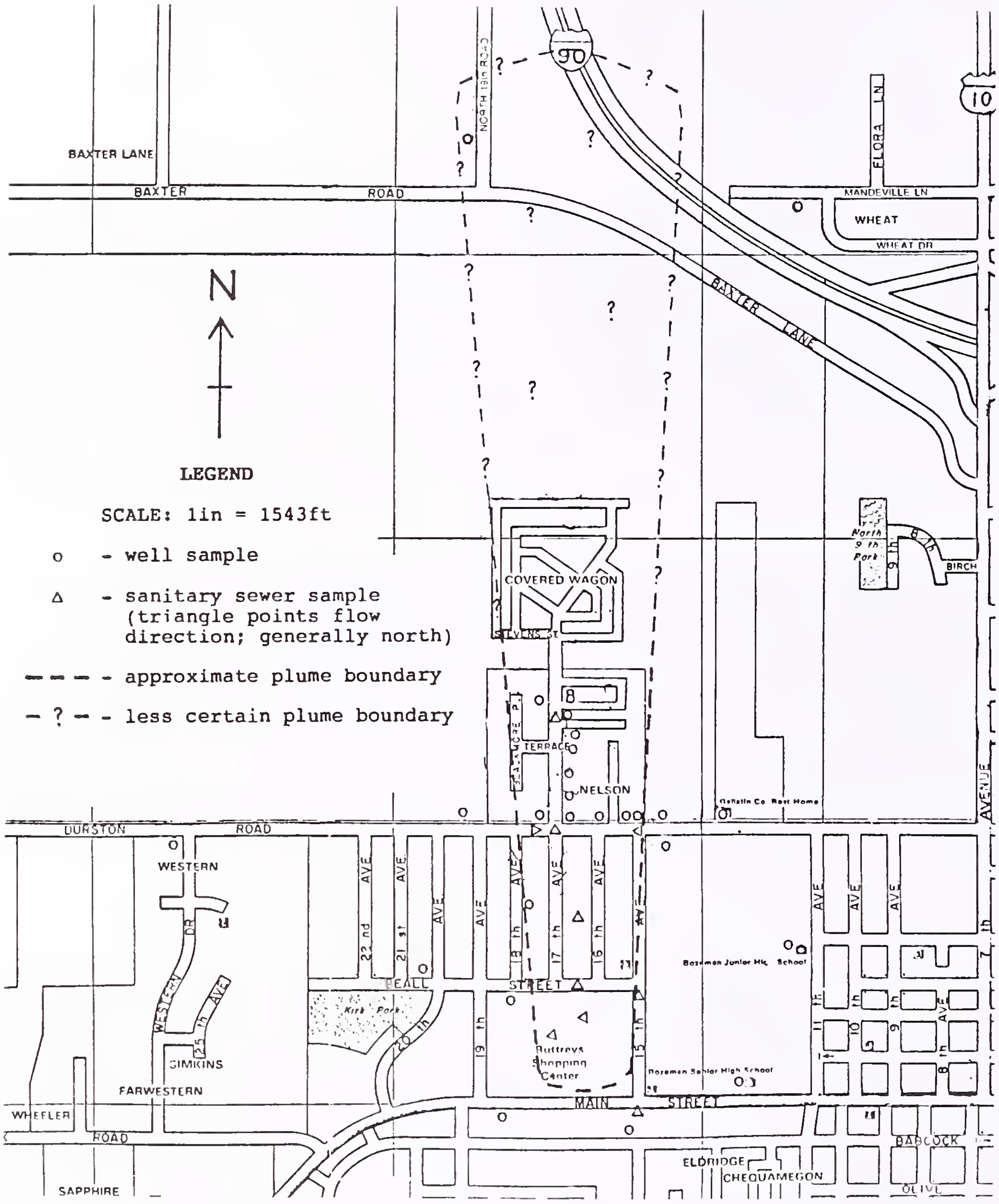


Figure 1. Map of sample sites and approximate plume boundary.

HOW DID THE CONTAMINATION OCCUR ?

Although identification of the source of contamination (Phase II) was beyond the scope of the Phase I investigation, the sampling effort led to some preliminary work in this area. The WQB had learned that the groundwater flowed from south to north suggesting that the contamination originated at the southern end of the plume. This picture was confused by one well south (upgradient) of the trailer court that had lower, but significant, contaminant concentration than the trailer court wells. The low concentration at the anomalous upgradient well might represent a location at the edge of the plume or it could be caused by the contaminant being introduced to the aquifer at different locations, such as might occur if it leaked out of sewer lines at several points. A sample was gathered from the sanitary sewer that ran past the trailer court and PCE was detected.

Introduction of the solvent into the groundwater from sanitary sewer leakage could mean that contamination occurred in various spots following sewer lines and not aquifer flow lines. This is difficult to confirm because an information gap exists in the 2400 feet between the trailer court wells and the upgradient extent of the plume. This gap is due to a lack of wells; the intervening residential area and shopping center are supplied mostly by city water. A map of the sanitary sewers overlying the aquifer was obtained from the city engineer. Sanitary sewer sampling continued following the flow and highest PCE concentrations upstream. The highest PCE concentrations in the sanitary sewer, 296 µg/l, occurred near the upgradient end of the plume. The obvious conclusion is that disposal of PCE into the sewers may explain the source of contamination; however, it is possible that the PCE is leaking into the sanitary sewers from the aquifer and not the other way around. Approximately $1,800 dollars was spent on sample analyses alone in this initial source investigation. More investigation is necessary to determine conclusively what the sewer samples are telling us.

As the WQB worked in the area gathering samples to define the extent of the plume, possible contaminant sources were investigated. A survey of possible commercial users of this chemical within the emerging plume boundaries was conducted with assistance from the DHES Solid and Hazardous Waste Bureau. The only business found to be currently using PCE was a dry cleaner. The only retail product containing PCE found in the area was a spot lifter sold in the grocery store for domestic use. It is unknown how many home workshops might contain the chemical or how much might be poured onto alleys or into domestic drains for disposal. Any of these sources could conceivably introduce enough of the chemical into sanitary sewers to cause the observed contamination if the sewers were leaking (remember how little is required to achieve the micrograms per liter concentrations).

Other possible aquifer contaminants found

Some of the investigation's findings are instructive as to the likelihood of this type of contamination occurring in other aquifers. While PCE was not found everywhere, other possible contaminants were found. In a flowing ditch for example, a partially filled oil container, a tube of caulking labeled as a skin and eye irritant and an underarm deodorant containing butane, propane and chlorinated hydrocarbons were found. Automobile repair shops were filled with an impressive array of solvents, paints and other products containing chemicals such as acetone, cellulose acetate, 2-butoxythenol, glycol esters, ketones, mineral spirits, toluene, xylene and zinc chloride. The gasoline at local gas stations contains benzene, toluene, ethyl benzene and xylene and some stations handle leaded gas and diesel fuel as well. Hardware stores contain additional chemicals that may cause pollution if handled carelessly. The bottom line is that lots of potential contaminants that may be hazardous to humans were discovered within this 0.25 square mile business/residential neighborhood overlying the contaminated aquifer.

The number of chemicals found isn't surprising when viewed in perspective of chemical use in this country. It is estimated that 5-6 million chemicals currently exist with approximately 6,000 new chemicals placed on the market each month. About 60,000 of these chemicals are known to be hazardous wastes. Since World War II chemicals have proliferated in our society, but public education about their inherent dangers has lagged behind use. The ready availability of thousands of dangerous chemicals to a relatively uninformed society has set the stage for this type of groundwater contamination.

Where do we go from here?

Phase I of the investigation is complete; the public has been appraised of the danger and alternative water supplies available to them and the approximate extent of the contamination has been delineated. Approximately $7,200 was spent on Phase I lab analyses.

Phase II operations will consist of the determination of the source of the contamination and ongoing monitoring of the plume ($2,520 already spent on monitoring analyses). As mentioned above, some Phase II work has already begun. The contamination is expected to remain a long time because groundwater moves very slowly compared to surface water (groundwater velocity is measured in feet/day) and because PCE is much less volatile in groundwater than in surface water. If the community wishes to use the aquifer again soon, cleanup may be justified.

Phase III will be concerned with clean up efforts once the source of the contamination and the transport route to groundwater is understood. The supply of contaminant at the source would be cut off and the transport route eliminated. A study of the feasibility of aquifer restoration would be conducted.

Phase IV will involve legal action to recover costs of the investigation and remedial activities, and to seek civil or criminal penalties, as appropriate. The Montana Water Quality Act (Act) allows for up to $10,000 per day of violation for civil penalties and up to $25,000 per day and up to 1 year imprisonment for criminal violations. The Act also allows the department to recover all costs associated with investigating and remediating the pollution in a civil action.

WHAT DOES ALL THIS MEAN TO WATER AND WASTEWATER PLANT OPERATORS ?

The WQB has detected chlorinated solvents in both groundwater supplying a public distribution system and sanitary sewers that discharge to a treatment plant. The WQB has also found that a large number of other hazardous chemicals are readily available for business and residential use in Montana. It is obviously impossible to supervise each and every user of these chemicals continuously. The evidence suggests that your groundwater supply wells are vulnerable to similar contamination and that your wastewater plant may be receiving a large variety of toxic and hazardous chemicals.

Throughout this article reference has been made to the cost of lab analyses associated with this investigation to date. The total for lab fees alone approaches $11,520 and the WQB has not yet drilled a single well. This type of investigation can get very expensive in a hurry and last for years. You might ask yourself how you would supply your community safe water while all this was going on.

WHAT CAN BE DONE TO PREVENT THIS TYPE OF CONTAMINATION IN OUR WATER SUPPLIES ?

The federal Environmental Protection Agency (EPA) is currently encouraging states to formulate "Wellhead Protection Plans". These plans would be developed for public water supply systems to define the areas recharging public supply wells and minimize the amount of potential pollutants used above these aquifer areas. The EPA would initially provide grants to interested states to develop specific wellhead protection area plans.

The EPA is also encouraging development of plans to prevent "non-point source" groundwater pollution. "Point source pollution" is pollution that is readily traceable to a single source, such as a discharge pipe from a shop. The groundwater pollution that might occur under a town with chemicals in every garage, under every sink, in every repair shop and dumped in every sewer is an example of non-point source groundwater pollution. A rural example of non-point source groundwater pollution is that which might occur under fields or road ditches sprayed with herbicides, insecticides and rodenticides. The EPA would also provide some grants to states with communities interested in preventing this type of groundwater pollution.

The WQB is currently searching for communities interested in participating in these pilot projects. You can help to educate your community about the need for such a plan. You can also inform the WQB of your community's need for such a plan and work with the WQB to develop it (Contact John Arrigo or the author). You can also develop a program at the community level to provide collection of these hazardous chemicals so that they are not disposed of inappropriately. The public often has no suitable disposal option available.

Your help is needed. The WQB employs only two groundwater hydrologists to handle all the pollution that might occur in over 1400 public groundwater supplies. The difficult nature of the problems we face clearly indicates the need for additional help. The EPA is willing to provide sufficient funds for the WQB to hire that help, but current administrative policy prevents hiring new personnel.

SUMMARY

The WQB has completed Phase I of the investigation, alerting the public, suggesting alternate water supplies and delineation of the approximate plume boundaries. Phase II of the investigation, determining the source and route of transit to the aquifer has begun. Phase III, aquifer cleanup, and Phase IV, legal action to recover costs and assess fines, depend partly on our success at locating the source.

This case study of a groundwater pollution incident suggests that the potential for similar problems in other public water supply systems is high. Montanans have always felt that abundant clean water was one of the benefits of living in this beautiful state. But Montanans are using the same chemicals that residents of America's crowded, dirty industrial cities use and many other chemicals are used here, such as pesticides, that potentially may be more toxic. Thousands of new chemicals appear on the market each month. The multitude of hazardous chemicals in the hands of the public, the public's limited knowledge of the relative ease with which they can cause serious groundwater pollution and the lack of suitable disposal methods combine to set the stage for more contamination. Groundwater contamination is expensive, the lab analyses alone conducted for this investigation to date approach $11,520 and the investigation is far from complete. The practical approach to this problem is prevention.

The EPA is willing to supply the state with funds to develop some pilot projects to protect wellhead areas and prevent non-point source groundwater pollution. Will you and your community act now while there may still be time to prevent these problems from occurring in your public water supply system?

Acknowledgements

Important help in this investigation has been given by Emery Nelson and Barbara Vaughn of the Gallatin County Sanitarian's Office and Larry Woodward of the Bozeman City Shop.

BSCW Editor's Note: Although this article addresses problems identified for wastewater treatment facilities, their significance and impacts are equally demonstrated in the water industry. These factors should be considered and rectified by administrators of both utilities.

FIVE PROBLEMS COMMON TO WATEWATER TREATMENT FACILITIES

by: Gary Champy
Financial Management Training Specialist
Vermont Department of Environmental Conservation

Since 1986, Vermont has helped 15 municipalities through its Financial Assistance Program, a program designed to bring wastewater treatment facilities into compliance with federal regulations. Of the ninety municipalities in Vermont that own wastewater treatment facilities, forty were targeted as potential program participants. These municipalities were sited because of the size of the treatment facility (under 400,000 gpd), the population of the municipality (ranging from 200 to 2,000), and the potential need for financial assistance for equipment replacement or major maintenance.

Each municipality that received financial management assistance required an individualized approach to solve five common financial problems.
These include:

Low Recognition & Pay for Operators
Wastewater treatment plant operators are underpaid and usually considered low priority in the municipality's management structure. Municipal officials generally find more time to deal with community matters in departments that are more visible or considered more prestigious by the community. This means that certain employees receive greater recognition in the community and municipal officials tend to elevate those positions. Municipal officials need to be aware of the importance of the wastewater treatment department and the people who

oversee the facility. The plant operator usually works more weekly hours, weekends, and holidays than any other employee. The plant operator is managing one of the most expensive investments in the community and the hourly wage should reflect this.

Restrictive Control of Purchasing

Wastewater treatment plant operators usually are required to get financial approval for routine operating and maintenance purchases. In most cases, this approval must come from a person having little or no knowledge and experience with wastewater treatment facilities. Wastewater treatment plant operators must be able to promptly carry out routine operating and maintenance requirements and must not be required to wait for a special meeting in order to purchase necessary items. Municipal officials must understand that the plant operator is the wastewater treatment expert and that delaying financial decisions directly affects the daily performance of the treatment facility.

Limited Budgetary Planning

The wastewater treatment plant operator is seldom involved in developing the yearly budget for the wastewater department. This is as area that many operators would like to become more involved in, but they seldom get the opportunity because municipal officials do not believe it is the obligation of the operator to assist in budget development. It is important for municipal officials to allow the wastewater treatment expert to be involved in the budgeting process and to become more aware to the municipality's financial resources since it directly affects the functioning of the wastewater treatment facility.

Lack of Set-Aside Funds

Municipalities usually do not have adequate set-aside funds to cover maintenance or equipment replacement. Municipal officials need to understand that it is in the municipality's best interest to increase user rates now and save money today instead of borrowing money in the future and then increasing user rates to pay back loans. Municipal officials must realize that saving money increases the municipality's ability to be self-sufficient by allowing it to bypass the bureaucratic red tape associated with state loan programs. Once municipal officials are made aware to the advantages of saving money now rather than borrowing money later, they will be more likely to plan for major expenditures five to ten years in advance.

Poor Understanding of Regulation

The final, and perhaps most common, problem is that sewer commissioners and municipal officials usually fail to consider federal regulations, state statutes, and local sewer ordinances when making management decisions. It is imperative that all municipal officials, even if they are only part-time employees, be aware of pertinent laws and regulations regarding wastewater treatment so that they can carry out their responsibilities within the law. Reviewing controversial issues and questions gives municipal officials the ability to confidently enforce laws and regulations that deal with owning, operating, and managing a wastewater treatment facility.

Reprinted from national Small Flows Clearinghouse's October 1989 issue Small Flows, with permission.

MONTANA SHINES !

Four of Montana's wastewater treatment facilities were recognized by the Environmental Protection Agency (EPA) for operation and maintenance excellence. Lewistown, Polson, and Superior were recipients of a National Operations and Maintenance Excellence Award from EPA. All three were selected as the best in EPA Region VIII in their category. EPA Region VII includes the states of Colorado, Montana, North Dakota, South Dakota, Utah, and Wyoming. The award speaks highly of the efforts of the many people who are involved in the successful operation of the communities treatment facilities.

Following is a brief description of each facility:

LEWISTOWN:

Facility Type: Rotating Biological Contactors (RBC)
Design Flow: 2.83 MGD
Date Constructed: 1986
Operators: Bill Rutherford - past Chief Operator
Wendell Wade - Chief Operator
Warren Bird - Public Works Director
Ken Hagen
Catherine Holzworth
Johnny Webb

POLSON:

Facility Type: Four-cell Aerated Lagoon
Design Flow: 0.675 MGD
Date Constructed: 1962
Operators: John Campbell - Water and Sewer Superintendent
Keith Wilmes
Roger Peek

SUPERIOR:

Facility Type: Two-cell Aerated Lagoon
Design Flow: 0.187 MGD
Date Constructed: 1969
Operators: Ben Poat - Wastewater Superintendent

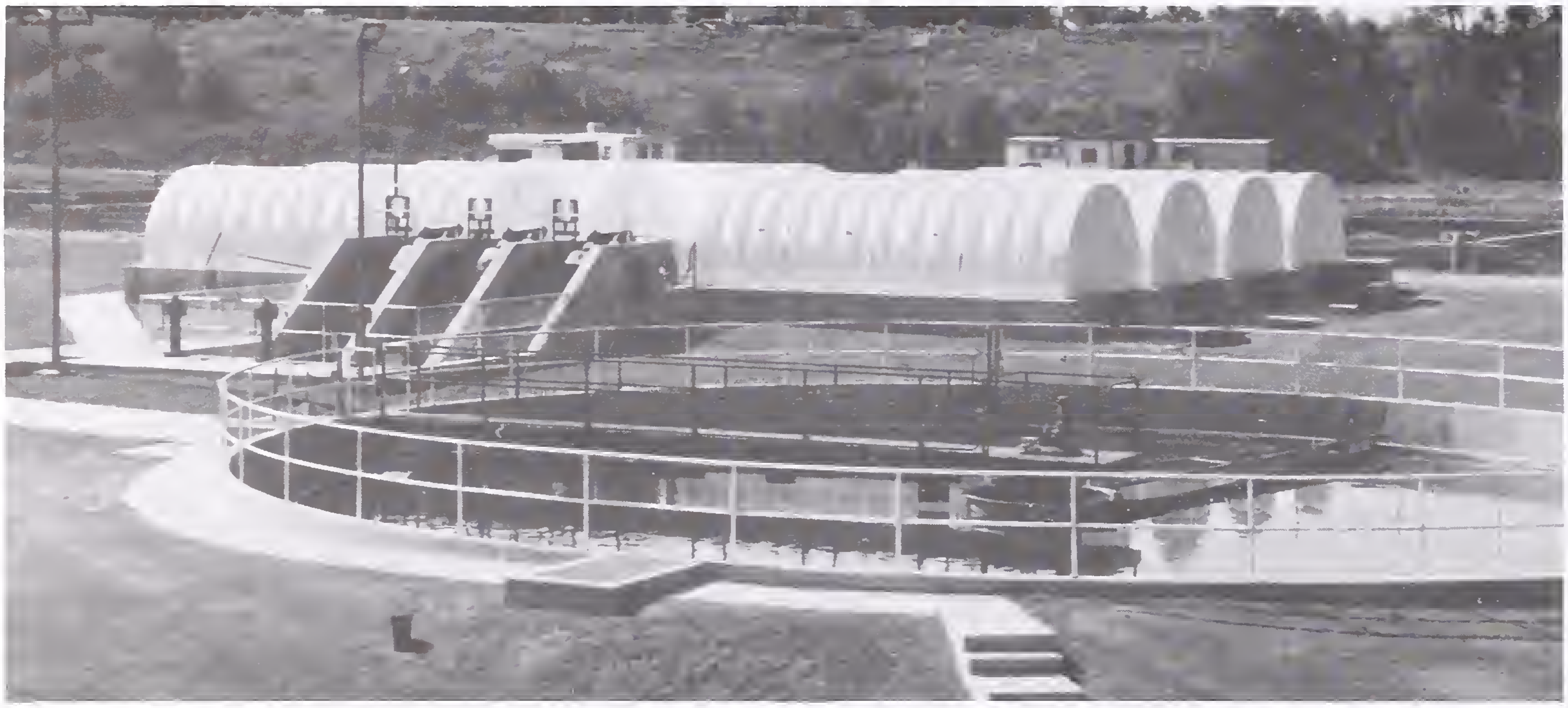
The City of Bozeman was presented the Beneficial Sewage Sludge Use Award by EPA. This award is for excellence in the area of beneficially handling sludge. The award recognizes the benefit of low sludge management cost, enhanced soil properties and crop production, monitoring to document low public health risks, good public relations, management practices, and monetary return. The award was presented to the city council of Bozeman then to treatment facility staff.

All the communities received their awards at ceremonies attended by community officials, EPA, Water Quality Bureau, and the news media.

These awards were highly deserved and reinforces the excellent operation and maintenance programs at the wastewater treatment plants. Our hats are off to the staff's of the four facilities. Keep up the good work!!!!!

EPA Regional Administrator Jame J. Scherer presents Lewistown's Wastewater Chief Operator Wendell Wade with an O & M Excellence Award.

The Lewistown Wastewater Staff with their O & M Award.
l. to r. Johnny Webb, Mero Siroky, Warren Bird, Catherine Holzworth, Ken Hagen, Wendell Wade, and EPA Regional Administrator James Scherer.


The award winning Lewistown RBC WWTP.

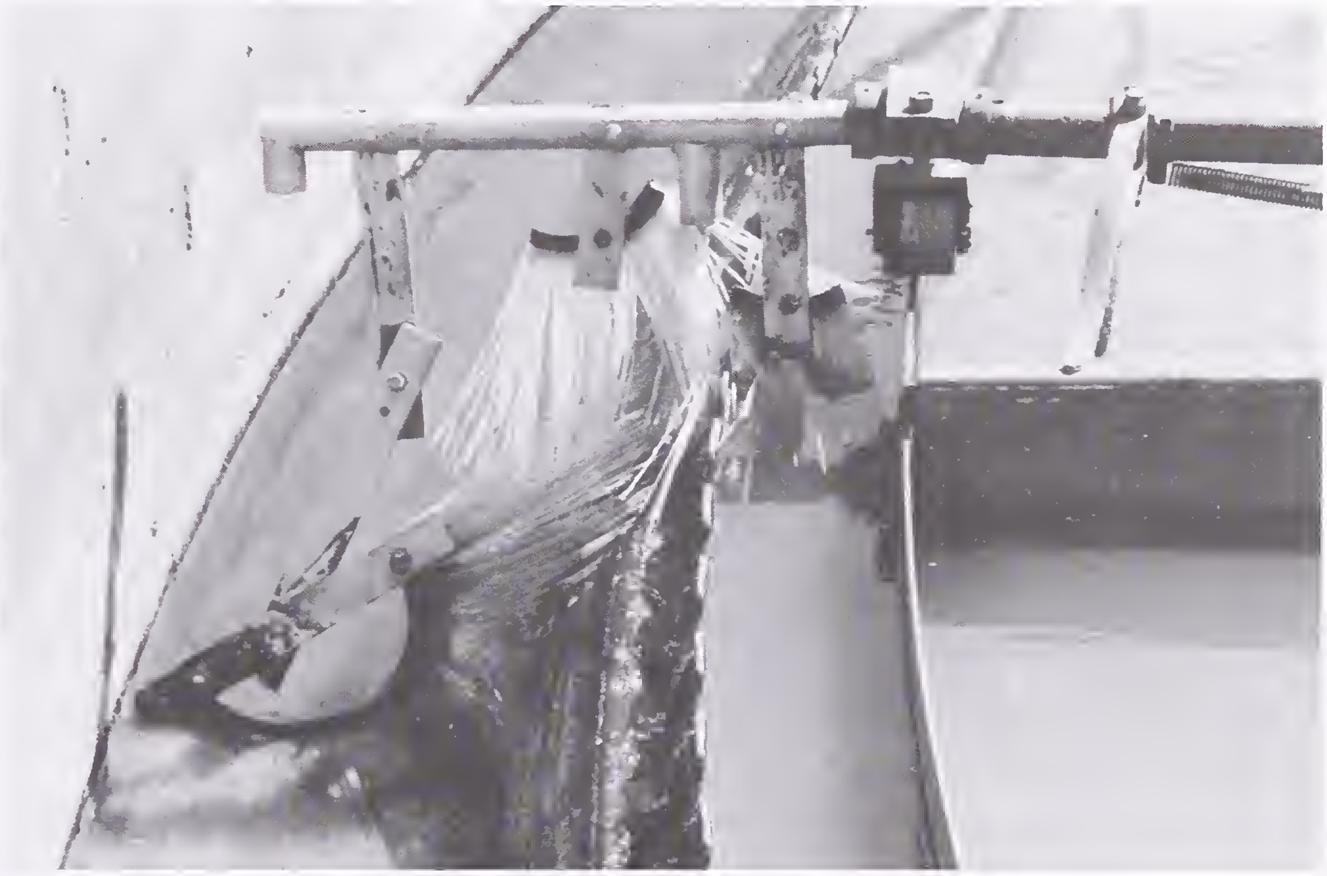
John Wardell, Director of the Montana Office of EPA's Region VII presents John Campbell, Polson's Wastewater Superintendent, with an O & M Excellence Award.

Roger Peek, John Campbell, and Keith Wilmes at the Polson lagoon with their O & M Excellence Award.

John Wardell, EPA, and Ben Poat, Wastewater Superintendent, with Superiors O & M Excellence Award.

Ben Poat Superior Wastewater Superintendent at his award winning facility.

This innovative way of keeping clarifier weirs clean was developed by the staff at the Lewistown wastewater treatment plant. As shown in the picture, an extension was put on the clarifier rake arm and some stiff brushes were attached to the extension. As the rake arm travels around the clarifier the weirs are brushed clean. Once again, operator ingenuity pays off.
Keep up the good work Lewistown!



Science Classes Learn from Operators

By Cathy Holzworth, Lewistown WWTP

The operators at the Lewistown Wastewater Treatment Plant have, for the past three semesters, participated in the instruction of an ecology class at Fergus High School. Students in the class, taught by Mr. Gail McIntyre, are juniors and seniors requiring science credit for graduation. During the course, water and wastewater treatment and water pollution are considered; at this time the Lewistown operators are called in to take over the class. The chief operator introduces the week-long program with a slide presentation of the wastewater treatment facility and a discussion of career opportunities. The next day's lesson, prepared by the lab technician, relates ecological principles the students have previously learned to the various treatment processes. Microscopic examination of the slime on the rotating biological contactors permits the students to study food webs and pyramids "up close". The last three days of the week are spent at the plant, where the students are given hands-on experience on laboratory tests performed for the Environmental Protection Agency and process control. Drinking water tests are demonstrated and EPA regulations discussed by the Lewistown Water Quality Lab Technician. A tour of the wastewater treatment plant completes the week's activities.

THE WATER COLUMN

News from the Water Quality Management Section
Loren Bahls, Section Head
Water Quality Bureau
Environmental Sciences Division
Department of Health and Environmental Sciences
Cogswell Building, Helena, MT 59620

HOWDY !

Let me introduce you to the Water Quality Management Section. We are seven environmental specialists, a secretary, a computer programer, and a resource conservationist on loan from the Soil Conservation Service. Montana's comprehensive water pollution control program has several interrelated components as provided by state and federal law. These include Permits and Compliance Monitoring, Enforcement, Groundwater Protection, Construction Grants, Operator Training and Certification, Water Quality Standards, Public Water Supplies, and Sanitation in Subdivisions. The Water Quality Management Section of the Water Quality Bureau is responsible for three elements of this comprehensive program: 1) nonpoint source control, 2) water quality monitoring and 3) water quality management planning. We also provide supporting services to nearly all of the other components of the comprehensive program.

Nonpoint Source Control Montana has over 7,000 miles of polluted streams. Surveys show that about 95% of these waters are impaired by nonpoint sources, for example cow pastures, logging roads and abandoned hardrock mines. The 1987 amendments to the federal Clean Water Act gave the states primacy in developing and implementing nonpoint source (NPS) control programs. EPA has approved the agriculture part of Montana's NPS program and we are expecting approval soon of our forest practices and mining plans. Jack Thomas is coordinator for the State's NPS control program. Jack is assisted by Kit Sutherland, Larry Brown, Steve Tralles and Alan Harbaugh.

Monitoring With today's emphasis on management for environmental results, accurate and reliable ambient water quality data are needed to measure the effectiveness of pollution control programs and projects. Other uses for ambient data include screening for emerging problems, setting priorities for cleanup, setting use classifications and standards, and allocating pollutants among various sources. We are a monitoring service group to sections and programs that use ambient data, including Permits, Water Quality Standards, and our own NPS program. Gary Ingman heads our Clark Fork River Basin monitoring project. Mark Kerr is data quality assurance coordinator for the Bureau, and Bob Bukantis provides bioassessment and bioassay services.

Planning A certain amount of assessment and planning must precede any decision to implement water pollution controls. This is especially true if controls encompass an entire river basin or water shed or if they involve both point and nonpoint sources of pollution. Section staff have provided assessment and planning assistance to county health departments and conservation districts, the Flathead Basin Commission, the Forest Practices Cumulative Effects Cooperative, the Clark Fork River Basin Interagency Task Force, the

International Joint Commission, various Superfund projects, the Department of State Lands, and other units of state government. We also review plans for new mines, timber sales and construction projects in stream channels, and evaluate these activities for compliance with water quality standards.

Some of our functions don't fit neatly into one of these three categories. We also: write environmental assessments and sections of environmental impact statements; conduct intensive surveys for toxic and conventional pollutants; write "discharge permits" for feedlots; issue short-term exemptions to the turbidity standards for instream construction projects; report water quality conditions and treads to EPA and the public (the "305(b) report"); coordinate an EPA-approved QA/QC program for the Bureau; manage biological and water quality assessment data; provide technical consultation to other sections of the Bureau; and identify aquatic organisms, including suspected toxic algae and the many little "buggies" that people bring to our door. All of our environmental specialists are on call to investigate complaints of water pollution and to follow up on fish kills with the Department of Fish, Wildlife and Parks.

We work very closely with Abe Horpestad and Tom Reid of the Technical Studies and Support Section on many of the activities listed above.

I hope that this brief sketch has given you a better idea of who we are and what we do. For more information, stop by and see me in Room A-204, Cogswell Building, Helena; call 444-2406; or write to the Water Quality Bureau.

Section Staff

Environmental Specialists:
Larry Brown
Bob (Bert) Bukantis
Gary Ingman
Mark Kerr
Jack Thomas
Steve Tralles (Gomez)

Computer Programmer:
Alan Harbaugh

Secretary:
Pam Brewster

Resource Conservationist:
Kit Sutherland

MSAWWA News

The AWWA Water Utility Council is actively involved in legislative and regulatory activities pursuant to the 1986 Safe Drinking Water Act Amendments

The following is an update from fall, 1989 of what's happening on a National Level.

Ralph Dunahoo
Director, MSAWWA

LEGISLATIVE:

Appropriations - Although Congress appears to be listening to us, it may be only with one ear. We're working with other organizations and the Congress trying to get EPA about ten million dollars more for state drinking water program grants. There are also some increases in the dollars for technical assistance and education, but most of that is "fenced" to organizations other than AWWA. There is also a minor increase provided for drinking water research.

Lead - We are continuing to work closely with AMWA on a lead legislation package that incorporates our three-pronged approach: elimination of lead in the source water, corrosion control and public education. This approach recognizes the need for some tap sampling, but avoids both compliance responsibility at the tap and mandatory lead service line removal. We may need grass roots help in the sections in the near future.

Groundwater - We have drafted a concept paper on groundwater legislation that will be circulated to potential coalition members and other interested parties in the near future. We are also working with EPA's groundwater legislation task force. AWWA is stressing federal guidance and state control, with a strong a emphasis on wellhead protection program initiatives.

Conservation and Plumbing Efficiency - With the help of the Technical and Professional Council's conservation committee we have been working with Senator Fowler's office for about a year on this issue. We are supportive of most measures within the Water Conservation Act (HR 3099/S1422). Basically we support the principle of using the most efficient plumbing as proposed in the Plumbing Efficiency Act (HR 1185/S585), but we have some concerns about specifying flow rates in the law.

Rural Water Assistance - This is fast becoming a significant priority in Congress, and several bills have been introduced that would provide grant or loan dollars to rural systems. Three different federal organizations are being championed by various members of Congress for control of these dollars: the Department of Agriculture, the Environmental Protection Agency and the Corp of Engineers. AWWA favors EPA in this regard, but we are coordinating our position with that of the National Rural Water Association as closely as possible. How all this will be funded is still an open question -- don't look for very much to be decided this year.

Infrastructure - The infrastructure issue continues to run hot and cold. AWWA is a member of several coalitions working on this issue, most of which are looking for federal dollars that are simply not there. We continue to stress the need for doable solutions with strong local control.

Clean Air - President Harry Snider has written to President Bush (notice the protocol!), key members of Congress and the EPA Administrator, supporting the Administration's proposed clean air legislation. The entire Clean Air Act package is currently under heated debate on capitol hill, and we'll be watching developments very closely. We will also have to work closely with EPA on resulting regulatory programs because of the implications for water utilities with respect to hazardous air pollution regulations and other potential problem areas.

Wetlands - The wetlands issue will have a profound impact on future water supply development projects. We can expect a tough, environmentally oriented national policy and stiff rules concerning "no net loss" of wetlands. This is a major new policy direction for the administration, and we will give it maximum coverage in all our publications.

Safe Drinking Water Act Amendments - A new technical advisory workgroup (TAW) chaired by past president Bob Hilbert has been appointed to work on this issue, and will be managed for AWWA by AMWA. Starting with suggestions developed by the WUC's SDWA amendments committee, the TAW will develop a workplan this fall. This issue is priority number one on the legislative agenda for 1990, and we anticipated a major effort.

REGULATORY:

Lead - Longstanding and somewhat convoluted negotiations with EPA on this issue continue, with the focus of action currently in the National Drinking Water Advisory Council (NDWAC). EPA's new direction now includes an MCL at the tap of 10 ug/L. We have previously testified before the NDWAC and recently filed detailed comments opposing this new direction, and have strongly suggested to EPA that the entire rule should be republished for public comment. As indicated above in the legislative area, we favor the three-pronged approach of lead elimination, corrosion control and public education. We are sensitive to the public perception problem concerning the MCL at the tap issue, and believe our three-pronged approach is a positive, more effective means to reduce public exposure to ingested lead through drinking water. As another part of the lead issue, mandated "orderly" removal of lead service lines is under active consideration. The corrosion by-products TAW is currently developing a WITAF project to perform a cost/benefit analysis on lead service line removal. We need to know how much actual reduction of lead in drinking water will result form the removal of lead service lines.

Surface Water Treatment Rule - The final rule here is a tough one, but we have been able to hammer out something that is achievable and we fully support voluntary compliance. A companion guidance document is being prepared by the EPA, and we continue to negotiate issues of concern. In that regard, the Filtration and Microbial TAW under the leadership of Steve Hubbs has successfully negotiated language in the guidance document that will facilitate compliance with the five log deactivation of microbial contaminants required under surge conditions of high turbidity.

Total Coliform Rule - The rule as published presents a problem with respect to false positive tests that present no health risk yet trigger acute public notice. We have heard from a large number of utilities who will be adversely affected by this, and are attempting to reopen negotiations on the final rule along two tracks. We have made a protective filing with the courts, and will petition EPA to augment the rule with some type of waiver mechanism addressing the false positive/acute notice problem. Additionally, we are attempting to accelerate EPA approval of the "Colilert" test for the presence of E-Coli. If successful in negotiating with EPA, our legal option through the courts will not be needed. It is important to note that we are not opposing the rule itself; rather, we are attempting to eliminate needless problems of compliance and acute public notice, while improving analytical capability. The TAW continues to document this very real problem as a basis with our discussions, and scheduled a formal meeting with EPA for October 31, 1989.

Radionuclides - Because all of the radionuclides are classified as group A - known human carcinogens - MCLG's are to be set at zero. At this time our best estimates of where MCL's will be set are as follows:

Radon - 200 to 2000 pCi/L (water)

Radium 226 - 5 pCi/L

Radium 228 - 5 pCi/L

Uranium - 20 to 40 pCi/L

Beta particle and photon emitters - 4 mrem

For water utilities the most important contaminant at issue is radon, and the Radionuclides TAW is currently working with the AWWA Research Foundation on a high priority project to provide EPA with data on the contribution of radon in drinking water to the recognized threat of radon in air. We anticipate that this rule will be proposed by EPA in June of 1990.

Disinfection and Disinfection by Products - Our TAW on this major issue is extremely active and already inputting to EPA informally. The TAW has a whole series of projects planned, the first of which is to create a sound data base of information that will also indicate where the real voids are. We anticipate that the proposed rule will be keyed to some surrogate parameter such as total trihalomethanes, and expect a proposal sometime in 1991.

Organics and Inorganics (Phase II) - The proposed rule sets primary standards for 38 contaminants, and several secondary standards. Two of our most active TAWs (IOC & Corrosion By-Products and SOC & Pesticides) have submitted detailed comments to EPA. Among our particular concerns are:

1. Vulnerability Criteria -- we are represented on EPA/ASDWA's steering committee to define these.
2. An unrealistic secondary standard for aluminum proposed at 50 ug/L.
3. Laboratory capability with respect to some very low MCLs.
4. Occurrence data is extremely vague.

Several issues are being considered for possible referral to legal counsel. We plan to continue to provide input on this critical rule, despite closure of the docket to public comment. EPA is targeting the final rule for December 1990.

Organic and Inorganic Chemicals (Phase V) - This group of 25 chemicals is the remainder of the original 83 SDWA pollutants. EPA plans to propose the rule in March 1990, possibly excluding arsenic because of classification problems that have not been resolved. Some of the TAW's efforts under Phase II are being channeled toward Phase V.

New Contaminants Priority List - Our Contaminants Listing TAW is currently working with a group of state health officials concerning contaminants to be listed for future regulation. Hopefully through this cooperative effort we can bring some sense to the SDWA requirement that 25 new standards be developed every three years. We expect that the final rule will be a balanced one acceptable to all parties, with publication early this fall.

Primacy - We anticipate publication of the final rule sometime in the near future. The Montana Section may ask your support on the State Level.

Fluoride - The SDWA requires that all primary standards be reviewed every three years. EPA's review of the fluoride rule has been initiated, and may result in some heated discussion concerning health effects with the possibility of significant regulatory impact on utilities.

* * * * * * * * * * * * * * * * * * *

MSAWWA WELCOMES NEW MEMBERS SINCE JULY 1, 1989

Rick Marvel, Bigfork
Dave Schneiter, Billings
Mark Story, Bozeman
Brenda Wilson, Helena
Allen Eggen, Billings
Bernard McDonald, Great Falls
Donald Jackson, Billings
Gerald Grabofsky, Havre
Tim Miller, Havre
Harvey Wicklund, Bigfork

THANKS RECRUITERS

Donna Howell (2)
Dan Kandilas (1)

WELCOME NEW MULTI-SECTION MEMBERS

Roger Duffey, Exeter Supply, P.A.
Kevin Marback, TX
Calvin Noddings, CA
Walter Sohlesier, N.Y.
Lawrence Sistler, CA
Bruce Thill, NE

MWPCA President's Corner

By Tim Hunter, President

The year has been a busy and memorable one for all of us. Probably the most memorable portion being the "shaking" experience some of us had at the sixty-second annual conference of the Water Pollution Control Federation held in San Francisco, California in October. I was able to attend this national conference for the first time this year, thanks to my employer, the City of Missoula. I was overwhelmed by the multitude of information, the technology, and the advancements in our field which were presented before the conference was cancelled by the earthquake.

I had the opportunity to meet the members of the Operations Challenge team representing our neighboring association, the Pacific Northwest Pollution Control Association, (PNPCA). One of their members was a woman who was originally from Montana. I had no trouble cheering for them during the competition; although, I would rather have been cheering for a team from Montana. Several PNPCA members were there supporting their team and videotaping the events. I talked Gail Olrich, from Spokane, into coming to our conference to show the tapes and try to get some of our Montana folks fired up about this competition. Aside from the earthquake, I thought the operations competition was the highlight of the conference.

Although the news media focused on the collapse of the Nimitz freeway, the damage to the bay bridge and the devastation in the marina district, damage to the wastewater conveyance and treatment systems in the area was also significant. Stories of the diligence and professionalism demonstrated by members of the wastewater profession during the earthquake are featured in the latest Operations Forum magazine. Have you done anything about emergency preparedness in your facilities lately?

The MWPCA board met in Bozeman on September 25, 1989. We discussed plans for the conference, which will be held in Bozeman in March. We also spoke to many of the participants from the annual operations school at our jointly-sponsored (with MSAWWA) happy hour. This year, we had all of the participants sign a list so that we can contact them with membership information at a later date. Plans for the conference in Bozeman are coming along. Hope to see you all there.

ATTENTION:
Wastewater Operators

Herein you will find an application for membership to the Quarter Century Operators Club. To be eligible for membership to this prestigious club you must have been actively involved in the hands-on, day to day operations, maintenance, or management of a Wastewater Treatment Plant for at least 10 years and have been involved a total of 25 years in one or more aspects of the Water Pollution Control Industry.

You need not have been a member of the WPCF or your local MA for 25 years, but you do need to become a member before your application will be considered. If you have been in this business 25 years or know of a fellow worker who has, please take the time to fill out the application and send it in.

Membership to this club brings with it the respect of all operators who realize the positive impact your 25 years of service has made to the growth of our profession, not to mention the beautiful plaque which is awarded by the Water Pollution Control Federation. Please be sure to get your applications in by June 15, 1990.

WATER POLLUTION CONTROL FEDERATION **QUARTER CENTURY OPERATOR'S CLUB**

Eligibility Requirements — Application for Membership

1. Must be a member of a Member Association of the Water Pollution Control Federation.
2. Must have been in operations at least 25 years before applying for membership and must have been an operator for at least 10 years during a total of at least 25 years of full-time, significant participation in some substantial aspect of water pollution control (military service excepted). An operator is defined as a person actively involved in the hands-on, day-to-day operation, maintenance, or management in a wastewater transportation or treatment works.
3. Must submit an application for membership consideration. The application must be accompanied by a complete and detailed resume of experience.

Name ______________________ Phone Number ____________

Address ______________________

Present Occupation ______________________

Member Association ______________________

If you hold a Dual Membership indicate which Member Association name should appear on the Quarter Century Operators' Club certificate ______________________

Have you been actively involved in the hands-on, day-to-day operation, maintenance or management in wastewater transportation or treatment works for at least 10 years? ______________________

When and for what period? (Give Dates) ______________________

____

Where? ______________________

What type of works did you operate, maintain, or manage? ______________________

Have you spent the remainder of the 25 years in significant participation in one (or more) substantial aspect of water pollution control (military service excepted)? ______________________

References (at least three, preferably members of the Club)

____

____

____

Attach resume of experience complete and detailed.

Date ____________ Signed ______________________

Address ______________________

____

Send to: Executive Office
Water Pollution Control Federation
601 Wythe Street
Alexandria, VA 22314-1994

POLISHING THE APPLE

by
Curtis W. Myran
Miles City Water\Wastewater Superintendent

The Miles City Water Treatment Facility was constructed in 1974 and consists of a presedimentation basin (which is in the design phase for upgrading in 1990) followed by conventional treatment with lime softening.

The facility is owned and operated by the City of Miles City and serves approximately 10,000 people. Plant capacity is 7.2 MGD with an average of 500 to 600 million gallons of water produced annually. Average daily flows are 1.5 MGD with peak average daily flows of 3.0 MGD during the high demand months of June through August.

Miles City's raw water source is the Yellowstone River and a 230 GPM soda well. Raw water turbidity may reach and exceed 3,600 NTU's from March through June from river thaw and spring run off.

Because of unpredictable raw water quality during high demands, the presedimentation basin is important in relieving the solids loading to the two 500,000 gallon upflow contact basins inside the plant.

Poor design and deterioration of the existing presedimentation basin results in highs and lows of turbidities entering the contact units which affects clarifier performance, chemical cost, individual unit processes, and, ultimately, finished water quality.

Because of the type of system and complexity of this process design and along with the willingness of administration and operational staff, the Montana Water Quality Bureau and the City of Miles City agreed to do the first Comprehensive Performance Evaluation on a Surface Water Treatment Facility. The first field investigation began in late April, 1988.

The Comprehensive Performance Evaluation (CPE) was a thorough review and analysis of Miles City's facility design capabilities and administrative, operation, and maintenance practices. All areas were thoroughly reviewed and factors identified which were limiting optimum plant performance.

Factors limiting plant performance were classified as: A - a major long term affect on a repetitive basis; B - a minimal affect on routine basis, or major affect on a periodic basis; and C - minor affect.

The following factors were determined and classified in order of significance:

1. Application of concepts and testing to Process Control-Operations (A)
   Additional process control data needed to be collected and interpreted to set a process control direction which would result in optimum plant performance.

2. Process control testing - Operation (A)
   More frequent testing needed to be done to maintain desired quality of water produced.

3. Process Automation - Design (A)
   Concerns the need for continuous effluent monitoring and recording turbidimeters on the raw water, each individual filter, and the clear well.
4. Process Flexibility - Design (B)
   More flexibility in the chemical addition of coagulants for each plant process.
5. Lack of standby units - Design (B)
   This concerns the lack of a standby backwash pump.
6. Preliminary treatment - Design (B)
   Problems with the existing presedimentation basin include no chemical feed, short circuiting, backwash water getting into the low service intake area, and difficulty cleaning the basin.
7. Staff number - Administration (B)
   Increase in staffing in order to address operations and maintenance activities equally.
8. Sedimentation - Design (B)
   A combination of unlevel weirs and sludge accumulation in the basin corners results in solids carryover in basin effluent.
9. Disinfection - Design (B)
   A problem of short circuiting and inadequate contact time for proper disinfection through the clear well.
10. Return process streams - Design (B)
    Return of backwash water may affect quality of raw water.

Of these ten factors most were process control related or had emphasis on design. The CPE indicated that a followup Composite Correction Program (CCP) should be undertaken to address these limiting factors.

The CCP was initiated in January of 1989. Policies and procedures were developed to deal with the limiting factors determined in the CPE. The following action items were developed and implemented: new plant performance sheets and data forms to address expanded sampling and testing protocol; formalized procedures on night run operations; implemented the special studies approach to plant process; developed process control targets and parameters; purchased process control equipment, centrifuge, electronic blanket finder, and jar test apparatus; installed four in-line turbidity monitors for the four individual filters; installed sample taps on contact basin waste lines and on thickened sludge basin waste line; calibrated chemical feeders and checked chemical feed rates; shut soda well off during nonsoftening season; initiated routine controlled wasting from contact units; ran clarifier mixers continuously; tested for aluminum residual in raw water and plant effluent; and initiated routine jar testing and procedures. The evaluation of the action items took place from May through June 1989.

Improvement of contact basin performance was achieved through controlled sludge levels and concentrations, proper chemical dosage, and equal raw water flow to each. Each operator performed sampling, testing, and analysis techniques in the same manner, location, and time in regard to new procedures.

Lime sludge was removed from the contact basins just prior to the turbidity season, i.e., March through June. The sludge blanket was allowed to accumulate and be maintained just above the contact basin cone skirt (which extends to within six feet of the basin floor). Sludge for settleometer tests is taken at intervals of two, four, and six feet from the floor of the basins. Samples are taken from the flash zone of the mixing chamber and the concentrations are maintained between 10% to 15%. Core samples are taken prior to start up at specific locations and desired concentrations of 1.5% to 2.0% are maintained.

Taps on the contact basin waste lines allow for sampling of sludge concentrations and are maintained around 25% to 27% by volume. Flows to each basin are monitored daily and kept equally to attain a balanced chemical feed. From daily interpretation of sludge data and routine wasting, desired sludge levels were determined.

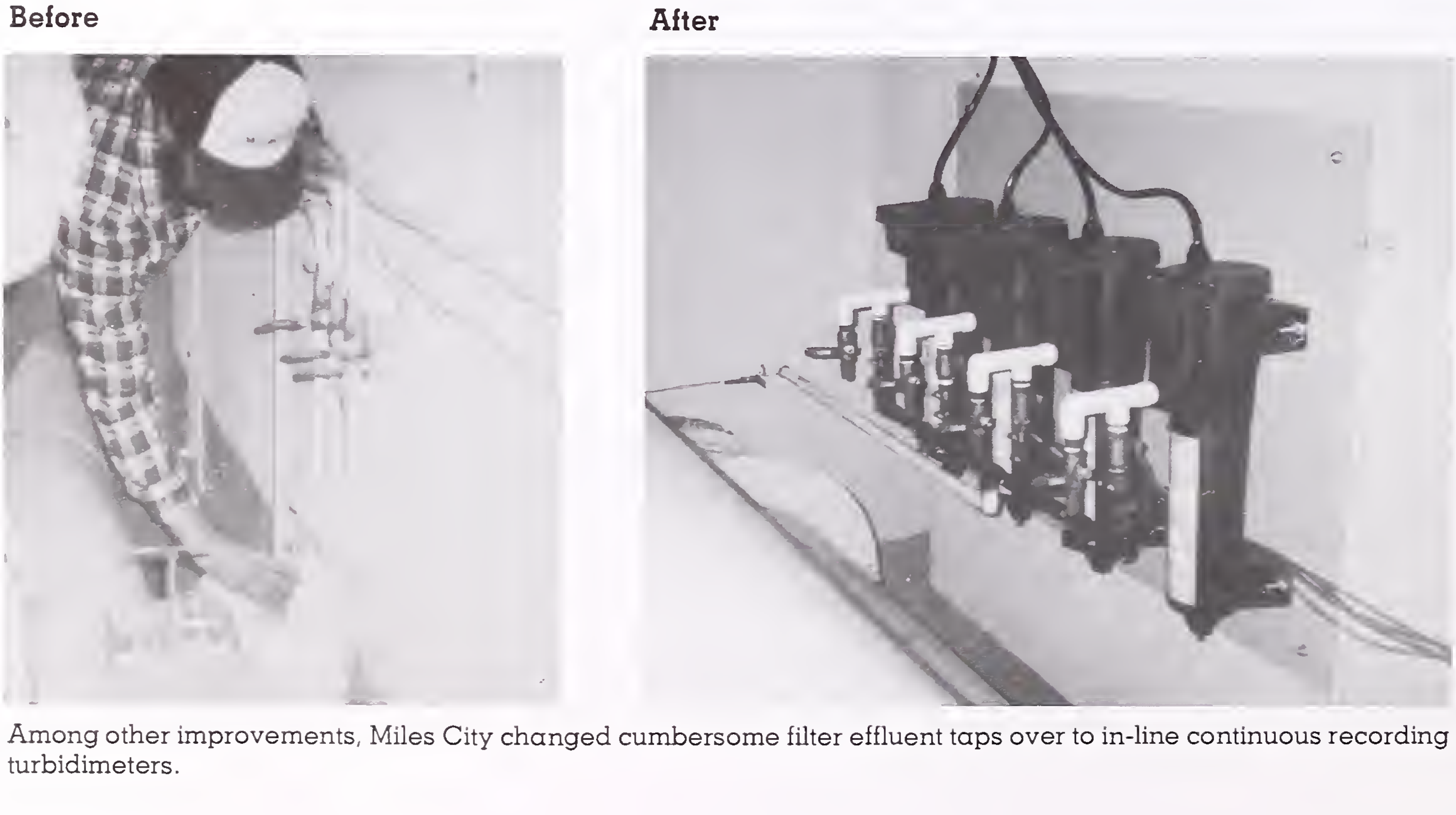
Clarifier stability was achieved and constant NTU values of 1.0 to 2.0 for the processed water were being sent to the four rapid sand filters. Consequently, filter run time was extended to 250 hours per filter with a filter effluent quality of 0.1 to 0.2 NTU's.

New concepts and ideas along with process control policies and procedures enabled us to improve the quality of water and reduce the cost of chemicals. The most important aspect of the CCP was the stabilization and equal performance of the two contact basins. Even during higher demands and increased raw turbidity, less filter turbidity spikes and longer filter runs resulted in a constant high quality water being delivered to the people of Miles City.

The Composite Correction Program Evaluation officially ended in August of 1989 with satisfactory improvement of plant performance. Even though the CCP has ended, optimization of plant performance is ongoing.

The Miles City Water Treatment Facility finished water quality continues to improve and, at present, processed water leaving the plant averages between .04 and .06 NTU's at a lesser cost.

Thanks to the Montana Water Quality Bureau, Process Applications, Inc., the City Administrative staff and especially the operators. We continue to polish the apple.



Before

After

Among other improvements, Miles City changed cumbersome filter effluent taps over to in-line continuous recording turbidimeters.

1990 JOINT MSAWWA/MWPCA CONFERENCE
MONTANA CLEANS UP

March 21, 22, 23, 1990
Holiday Inn, Bozeman, Montana

WEDNESDAY, MARCH 21 — MORNING

8:00 - 11:30 Special JEC Seminar - To be determined

AFTERNOON

Noon Conference Registration

12:30 - 3:00 Special JEC Seminar (continued)

1:00 - 7:00 Exhibit Area Open

3:00 - 4:00 Board Meetings

4:00 - 5:00 MSAWWA/MWPCA Joint Business Meeting

5:00 - 6:00 Social Hour

THURSDAY, MARCH 22 — MORNING

JOINT SESSION

8:00 - 8:30 Call to order: Jerry Lukasik, MSAWWA Chairman
Welcome: Mayor Bob Hawks
Invocation: Rev. Riley Grant
Response: Tim Hunter, MWPCA President

8:30 - 9:30 The Challenges Facing Montana Water Utilities:
Mike Patterson, Butte Water Company
Jerry Lukasik, Mountain Water Co., Missoula
Curt Myran, City of Miles City
Hugh Wilkins, City of Great Falls

9:30 - 10:15 Challenges to Montana's Groundwater Resources:
John Arrigo, DHES

10:15 - 10:30 Break

CONCURRENT SESSIONS
SESSION I/WATER
Ralph Dunahoo, Presiding

10:30 - 11:15 Missoula Well Head Protection Program:
Jim Carlson, Missoula Health Department

11:15 - 12:00 Water Reservations -- What is Important?
Joe Steiner, Billings

SESSION II/WASTEWATER
Kristi Kline, Presiding

10:30 - 11:15 The Implications of the New Sludge Regulations:
Speaker from HDR

11:15 - 12:00 WPCF Operations Challenge Competition:
Gayle Olrich

AFTERNOON

JOINT SESSION

12:00 - 1:30 Luncheon Speaker:
AWWA National President, Mr. Harry Snider

1:30 - 2:00 Exhibit Area Open

CONCURRENT SESSIONS
SESSION III/WATER
Denise Ingman, Presiding

2:00 - 2:45 Safe Drinking Water Act Amendments - An Update:
Dan Fraser, DHES

2:45 - 3:45 Are Your Utility Rates Keeping Pace with Replacement of Infrastructure?:
John Gallagher and Jim Wright, B&V

2:00 - 3:00 Livingston/Burlington Northern Site Cleanup:
John Mills, Envirocon

3:00 - 3:45 Treatment of Mine Water at the Butte Metro Wastewater Treatment Plant:
Bill Pasco, Butte

3:45 - 4:00 Break

SESSION V/WATER
Gerry Lukasik, Presiding

4:00 - 5:00 Backflow Preventers -- Are They Working?:
Harry Whalen, Rural Water

SESSION VI/WASTEWATER
Barry Damschen, Presiding

4:00 - 5:00 State Revolving Loan Program for Wastewater Facilities:
Scott Anderson, DHES

FRIDAY, MARCH 23 MORNING

JOINT SESSION
Terry Richmond, Presiding

8:00 - 8:45 Mini CIP System:
Robb McCraken, MT Dept. of Commerce

8:45 - 9:30 To be determined

9:30 - 10:15 What Citizens Want to Know about Hazardous Waste Cleanup Projects:
Warren McGee, Chairman, Livingston's Informed Friends of the Environment (watchdog group)

10:15 - 10:30 Break

10:30 - 11:30 Business Meeting

AFTERNOON

JOINT SESSION

12:00 - 1:30 Luncheon Speaker:
WPCF National Vice President, Mr. Roger Dolan

Montgomery Sapphire Presentation

1:30 Adjournment

* * * * * * * * * *

GREAT DEAL
for New AWWA Montana Section Members

INTERESTED IN JOINING AWWA?

Come to the membership booth at the March Conference in Bozeman and sign-up for **HALF PRICE.**

Bring your check or cash for *half* of the amount of an Active or Affiliate Membership and MSAWWA will pay the remainder. You **must** sign-up at the conference to be eligible.

COME SEE WHAT WE'VE GOT. ITS WORTH IT!

PRE-REGISTRATION FORM
1990 ANNUAL MSAWWA/MWPCA CONVENTION
BOZEMAN, MONTANA
MARCH 21, 22, 23, 1990

The annual meeting will be held at the HOLIDAY INN CONVENTION CENTER in Bozeman. Pre-registrants will automatically be entered in the drawing for a special piece of jewelry custom made by Dick Montgomery.

Pre-registration materials must be received by March 15, 1990. Make checks payable to MSAWWA/MWPCA HOST CITY COMMITTEE and mail along with this form to:

Howard S. Peavy
Water Resources Center
Montana State University
Bozeman, MT 59717

Room Reservations at the Holiday Inn can be made by calling 1-800-366-5101

Name:____
Last First Initial

Title:____

Organization:____________________________________

Address:______________________________________
Street/P. O. Box

____
City State Zip

Spouse/Guest(s) Name (if attending)______________________

* * Registration Fees * *

AWWA and/or WPCA members	$75.00__________
AWWA and/or WPCA members (one day only)	$50.00__________
Non-members *	$85.00__________
Non-members (one day only) *	$60.00__________
Spouse/Guest (all meals included)	$20.00__________
Additional luncheon tickets___Th ___Fr	$ 7.00 ea_______
Additional Banquet Tickets (Thursday night)	$18.00__________
Total Pre-registration Fees Remitted	$______________

* Non-members can enclose completed membership application along with one year's dues and register for the conference at member rates!

Please check here _______ if you are taking advantage of this offer.

TO: MSAWWA Section Members

FROM: Terry Richmond, Chairman
Honors and Awards Committee

SUBJECT: AWWA Awards for 1989 – 1990

Montana is fortunate to have many outstanding individuals that are deserving of special recognition for their accomplishments and contributions to the public through their involvement in AWWA and the water industry. Unfortunately, very few of these individuals are recognized annually for their efforts and accomplishments. As Chairman of your Honors and Awards Committee, I would like to encourage you as section members to help your committee nominate Montana individuals for various awards available through AWWA National.

In this issue of the Big Sky Clearwater is an AWWA Awards Summary which outlines most of the current AWWA awards. After reviewing this listing, fellow water industry operators, employees and utilities may come to mind that you believe deserve special recognition. Please let your Committee members know about these special people. We will see that you receive additional nomination criteria and entry forms and assist by processing all entries.

MSAWWA Honors and Awards Committee

Terry Richmond, Chairman
Morrison-Maierle/CSSA, Inc.
P.O. Box 1057
Kalispell, Montana 59901
(406) 752-2216

Denise Ingman
Public Health Lab. Bureau
Cogswell Building
Helena, Montana 59620
(406) 444-3444

Paul Torok
Seeley Lake Water District
P.O. Box 503
Seeley Lake, Montana 59868
(406) 677-2559

Ray Wadsworth
Montana Rural Water Systems
925 7th Avenue South
Great Falls, Montana 59405
(406) 454-1151

Mike Thomas, Systems Superintendent
Billings Public Utilities
P.O. Box 30958
Billings, Montana 59111
(406) 657-8345

SUMMARY AWWA AWARDS

Title	Purpose
Abel Wolman Award of Excellence	An award of excellence to recognize those whose careers in the water works industry exemplify vision, creativity, and excellent professional performance characteristic of Abel Wolman's long and productive career.
Abel Wolman Doctoral Fellowship	To encourage promising students to pursue advanced training and research in the field of water supply and treatment.
Academic Achievement Award	To encourage academic excellence and to give recognition to those graduate students who have made outstanding contributions to the field of public water supply through their work at a university.
AWWA American/ Canadian/Mexican Water Landmarks Award	To recognize and preserve an American, Canadian, or Mexican Water Landmark at least 50 years old that has had a direct and significant relationship with water's supply, treatment, distribution, or technological development.
Distinguished Public Service Award	The award for Distinguished Public Service, established in 1951 in honor of Harry E. Jordan who served as Secretary of the Association from 1936 to 1959, is presented in recognition of distinguished public service outside the line of duty by a AWWA member.
Education Award	To recognize students 19 years old or younger at the elementary, junior high, high school, or technical school level who have created a water related project of superior quality and to commemorate the exceptionally outstanding efforts of the late AWWA Past-President John H. Stacha to bring water education and water educational materials and information to the youth of the United States, Canada, and Mexico.
Gimmicks & Gadgets Awards	Recognition of inventive creativity by individuals.
Gold Water Drop Award	To recognize those individual members who have provided valuable service and support for AWWA programs and goals through their long-standing Association membership.
Heroism Award	This award shall constitute official recognition of an act of heroism on the part of an employee(s) in the water utility industry wherein the rescuer must have risked his own life in the process of aiding some other person or persons.

Honorary Member Award	This award is presented each year to individuals "whose knowledge and accomplishments in the field of water supply entitle him to special recognition." An Honorary Member shall have all the rights and privileges of an Active Member and shall be exempt from paying dues.
Operator's Meritorious Service Award	To recognize special performance by operators for compliance with public health standards, plant maintenance, development of new ideas, training, and outstanding achievement beyond normal operating responsibilities.
OpFlow Publications Award	To recognize the contribution to operating personnel of water utility systems in the areas of science, technology, and water supply operations as published in OpFlow.
Outstanding Service to AWWA Award	To recognize and honor a member of the American Water Works Association who has rendered outstanding service to the Association.
Research Award	The award, established in 1967 in honor of Dr. A.P. Black, recognizes outstanding research contributions to water science and water supply practices rendered over an appreciable period.
Safety Award	The awards, established in honor of Wendell R. LaDue, are presented to recognize outstanding accomplishment in safety by water utilities.
Section Education Award	To recognize AWWA sections for programs that educate water utility and industry personnel, the public, and elementary, intermediate, high school, and college students with regard to public drinking water supplies and the water supply industry and to disseminate guidelines that will enable other AWWA sections to conduct comparable educational activities.
Service to the Water Industry Award	To recognize those organization members who have provided valuable support for AWWA programs and goals through their longstanding Association membership.
Water Utility Hall of Fame	The Water Utility Hall of Fame was established in 1970 to perpetuate the memory of those living and deceased who have made the most significant contributions to the field of public water supply. The names of the members of the Hall of Fame are engraved on a bronze plaque at AWWA headquarters, and a plaque signifying membership is presented for mounting. If deceased, the plaque is presented to the institution or organization with whom the member is identified.

Fort Benton Selects Innovative Water Supply System

By Gary Swanson, Project Engineer, Robert Peccia & Associates

Fort Benton, a small community of 1700 people in central Montana had traditionally relied on a Missouri River water supply intake and a conventional surface water treatment plant. Faced with a deteriorating plant, and the prospect of having to invest in renovation of the old plant or construct a new water treatment facility, the City Council decided to examine alternatives.

ANALYSIS OF ALTERNATIVES

Robert Peccia & Associates was hired to identify and evaluate water supply alternatives. Since the groundwater in the Fort Benton area is highly mineralized, alternatives using groundwater were discarded. The Missouri River was considered the only reasonable water supply in the area. The water supply feasibility study was therefore limited to alluvial wells, induced infiltration radial wells, renovation of the old treatment plant, and construction of a new water treatment plant.

Alluvial wells were discarded from consideration because of water quality problems and the fact that the alluvium wasn't deep enough or sufficiently permeable to provide enough water. Renovation of the old treatment plant and construction of a new water treatment plant were not feasible alternatives because of their high associated costs. Also, the City's past experience was that their treatment plant suffered taste and odor problems with the surface water from the Missouri, and the plant had difficulty maintaining a satisfactory river intake because of fluctuating water levels.

Although not previously used in Montana, an induced infiltration radial well appeared to be the best alternative for Fort Benton. This type of water supply is essentially a method of withdrawing water from an aquifer that is recharged from a surface water source, and can only be installed in areas where conditions are suitable for their use. The necessary criteria are (1) that the formation must be rechargeable from surface water, (2) the formation must provide suitable filtration to meet turbidity standards, and (3) the formation must be permeable enough to yield an adequate supply of water.

INVESTIGATION

An investigation was made of communities where induced infiltration systems had been installed to determine the satisfaction of these communities with their systems, operation and maintenance costs, and the useful life of the existing systems. This investigation led to the conclusion that an induced infiltration radial well system recharged by Missouri River water would be the best available water source for the City of Fort Benton.

The selected infiltration well was manufactured by the Ranney Method Western Corporation. This induced infiltration radial well system consists of a caisson sunk adjacent to a surface water source with perforated laterals jetted out under the water source. (See Figure 1) Fort Benton contracted with the Ranney Method Western Corporation to conduct a detailed hydrogeological study to determine if an induced infiltration radial well system would work for Fort Benton. The results of the study indicated that such a system would indeed be appropriate for the conditions found at Fort Benton.

INSTALLATION

The induced infiltration system was completed in May 1986. Initial results showed higher than expected mineral content, probably due to contamination from adjacent mineralized groundwater. Testing indicated that the downstream lateral was causing most of the problems. This lateral was subsequently isolated and pumped to waste, which markedly improved the water quality. At this stage the water quality was still not up to expectations, but after examining the water quality test results and tasting the water, the City Council elected to complete the remainder of the project. Needless to say, the City Council and their engineer were both anxious and nervous about the suitability of the system and the ultimate satisfaction of the Fort Benton water consumers.

The pumphouse, pumps, controls, ultraviolet disinfection, chlorination system, and other equipment were installed and in operation by June, 1987. After a few months of fine-tuning and adjusting, the system is now working admirably. Continued operation of the system has apparently flushed the aquifer, and water quality is now near the predicted levels.

THE FUTURE

Some improvements to the system still need to be completed. Due to the limitations of the distribution system, the discharge pressure from the main lift pumps is about 25 psi higher than it should be. Improving the distribution system will increase the capacity of the induced infiltration supply and lower pumping costs.

Pumping to waste lessens the capacity of the radial well. In the future it is proposed to replace pumping the dowstream lateral to waste with a well system that intercepts the flow of groundwater into the radial well. The downstream lateral can then be used to increase the quantity of the water available for use. The main lift pumps have been designed such that adding impellers will allow the system pumping rate to be increased at minimal cost.

CONCLUSION

The Fort Benton water supply system is an unqualified success. Turbidity has been approximately 0.05 NTU, which is better than that achieved at many sophisticated water plants. No taste or odor problems have been encountered, and the previous intake problem has been eliminated. The water meets all EPA primary and secondary standards.

The induced infiltration system is far simpler than a conventional water treatment plant. Capital and design costs are much cheaper, and operational costs for the radial well are expected to be less than for conventional treatment.

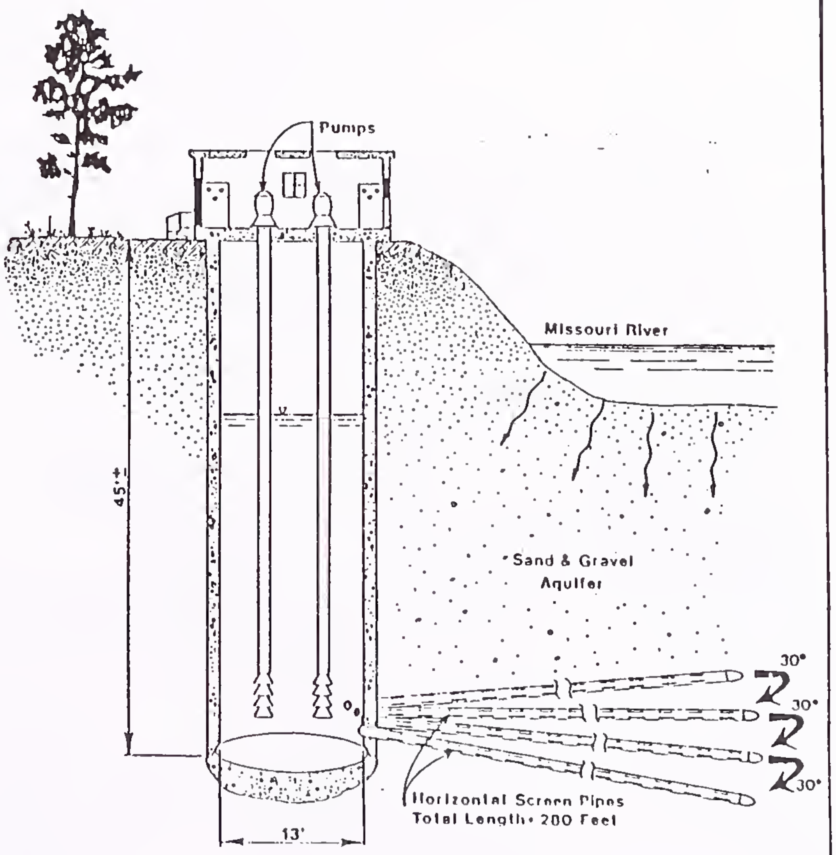


FIGURE NO. 1
Induced Infiltration Radial Well

Membership Application

Water Pollution Control Federation

601 Wythe Street
Alexandria, Virginia 22314-1994

Association

Montana Water Pollution Control Association

Use this application to join the Water Pollution Control Federation and your local Member Association. Simply complete this application and return it to the address below. Along with your monthly publications, you are also entitled to group insurance, technical assistance, discount on technical publications, and much more!

Please print.

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Last Name (16)
(Jr., Sr., etc.) (3)

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City (20)
State (2)
Zip Code - (9)
Area Code—Telephone - - (10)
Country (If Outside U.S.) (16)

WPCF Sponsor (Not Required) (28)
Sponsor's Member I.D. Number (6)

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- 27 – Industry
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- 2 – Training Courses, Short School
- 3 – High School
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TITLE

EMPLOYER'S NAME (if not already in mailing address)

APPLICANT'S SIGNATURE ____________ DATE ____

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ANNUAL DUES $____

NEG Assessment* ____

Multi-Section Option (other than own) ____

Total Due $____

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